Compressed Air Magazine

P. 6258

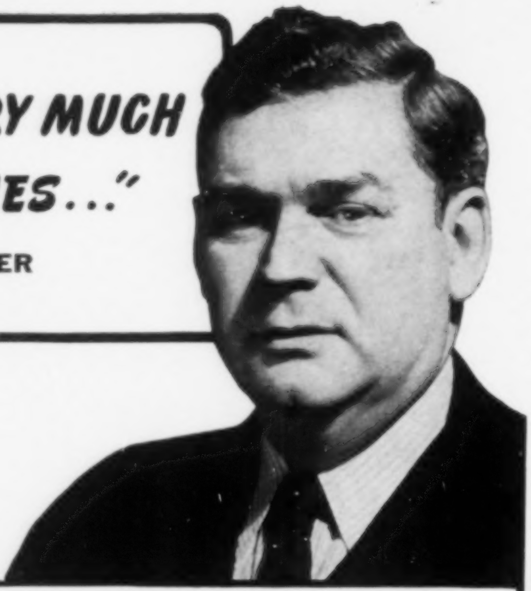
Vol. 45, No. 10 London - New York - Paris October, 1940

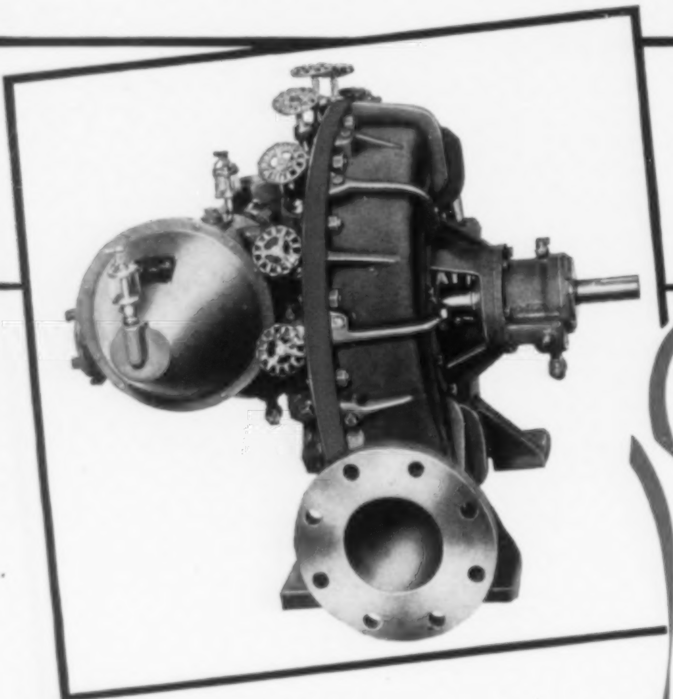
HOMECOMING OYSTER FLEET

EWING GALLOWAY PHOTO

"ALL OUR CUSTOMERS ARE VERY MUCH PLEASED WITH YOUR TURBINES..."

Says **LEADING PUMP MANUFACTURER**





Another COPPUS BLUE RIBBON *product*

"The turbines we have used of your manufacture have been doing very fine service and apparently all our customers are very much pleased with the units," writes a top-notch pump manufacturer to Coppus. No wonder. Besides the economy of buying a pump equipped with a small steam turbine to fit a small job — the user of Coppus Blue Ribbon Steam Turbines benefits from these other five product advantages:

(1) Precision workmanship — controlled by Johansson size blocks.

(2) Encased governor — slow speed, leverless.

(3) Separate safety trip — pilot-operated, leverless.

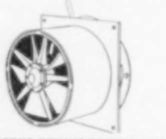
(4) Partial load economy — by individual nozzle control.

(5) Dynamometer tested — before shipment.

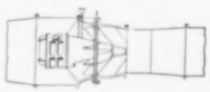
COPPUS

COPPUS BLUE RIBBON PRODUCTS

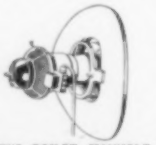
Designed for your Industry
Engineered for You



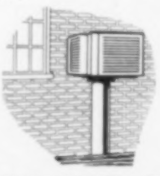
COPPUS-DENNIS FANMIX GAS BURNER. New method of mixing gas and air insures perfect gas-air ratio—instant, complete combustion. Bulletin 410-2.



COPPUS VANO BLOWERS. 1001 uses. High efficiency on special installations where ordinary fans fail. Bulletin 115-6.



COPPUS BOILER MANHOLE BLOWERS AND EXHAUSTERS. Swift cooling and ventilating. Easily and quickly attached to standard manholes. Bulletin 161-3.



COPPUS AIR FILTERS. For engines and air compressors. Perfect, uninterrupted filtration. Bulletin F-310-4.

WHAT THE BLUE RIBBON MEANS TO YOU

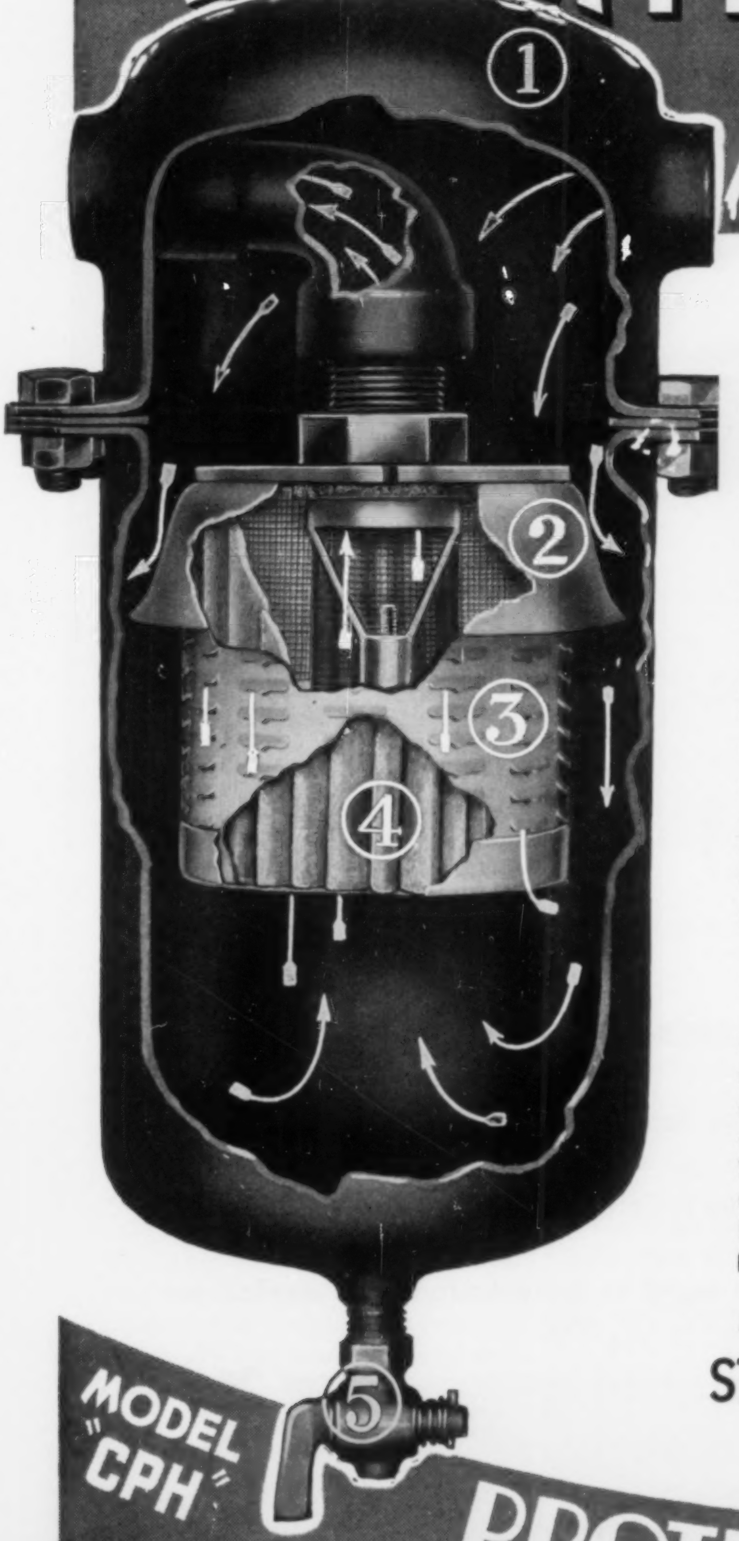
The Blue Ribbon on all Coppus products, is the mark of precision manufacture and vigilant inspection. As a result, 87% of our Steam Turbine orders in 1939 were repeat orders. Turbines can be operated by steam, air or gas. Write today for Bulletin 135-9, which describes vertical and horizontal types, and built-in speed reducers.

H. P. not E. P.* for small H. P. jobs

*Elephant Power — a large-size turbine for a job a small-size Coppus could handle. Save investment cost with a Coppus Turbine sized close to your needs.

Coppus Engineering Corp., 370 Park Avenue, Worcester, Massachusetts. Sales Offices in THOMAS' REGISTER. See SWEET'S for the other "Blue Ribbon" products—air filters gas burners, blower, ventilators, fans.

BETTER PROTECTION FOR AIR LINES IN COLD WEATHER



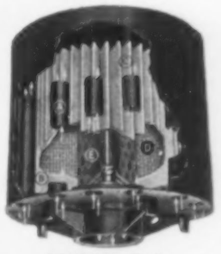
LOW TEMPERATURES CAUSE MOISTURE TO CONDENSE IN COMPRESSED AIR LINES, WASHING LUBRICATION FROM AIR-USING TOOLS, OFTEN SPOILING MATERIALS & PROCESSES. TO POSITIVELY REMOVE MOISTURE, USE PROTECTOMOTOR FILTERS ON ALL MAIN AND BRANCH PIPE LINES. . . . . . .

PROTECTOMOTORS *deliver clean air always*—Oil, pipe scale, rust, dirt and all other harmful foreign matter also removed from air and gas lines by Protectomotors. Repeat orders from hundreds of leading U. S. concerns prove that Protectomotors are real money savers.

CONSTRUCTION: 1. Seamless container with threaded intake connections. 2. Baffle. 3. Louvred filter housing. 4. Positive filter insert of exclusive Feltex Filtering Medium in famous Radial Fin Construction. 5. Drain Cock. Horizontal and vertical model filters available.

« LESS NOISE—LESS WEAR ON ENGINES »

Save wear and tear on men and machines. Equip noisy, hard-driven compressors and internal combustion engines with Staynew Silencer-Filters. "They silence the thump that hurts your ears"—and keep out abrasive dust, too. Write for catalog describing Model DS.


MODEL D S

Request: Data Blank for Free Analysis of your Requirements.

STAYNEW FILTER CORP.

ROCHESTER, N. Y.

MODEL "CPH"

ALSO FILTERS FOR
VENTILATION AND DUST RECOVERY
WRITE DEPT. 7 FOR CATALOG

PROTECTOMOTOR

GELAMITE
REG. U. S. PAT. OFF.
IN THE SPOTLIGHT

50 LBS.
INX 8
HERCULES
GELAMITE
I.C.C.-14
HERCULES
POWDER

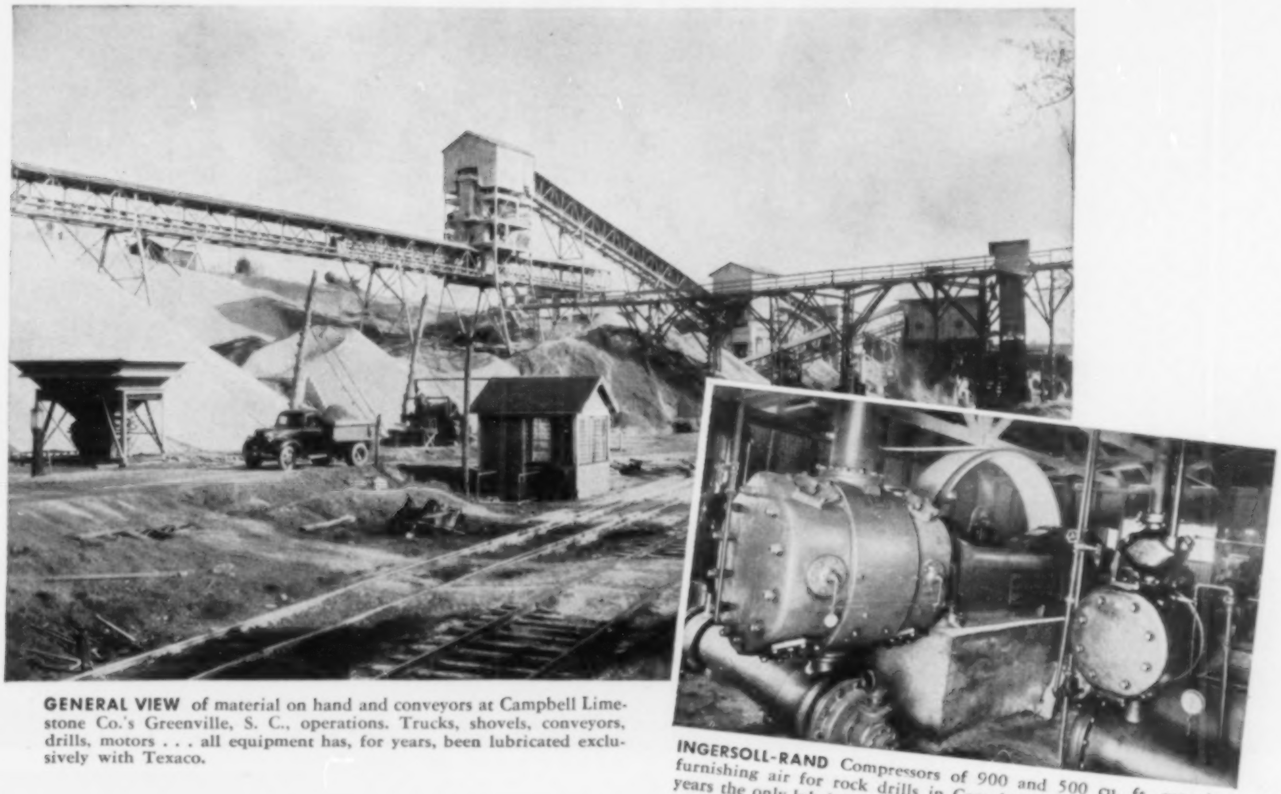
Eleven years ago a new type of explosive made its debut. It was the original semi-gelatin, named Gelamite (U. S. Patent No. 1,894,144). For eleven years, we've told you about the research behind it, the money it saves, its water resistance and fumes. It has earned a place in the spotlight.

- as the **BIGGEST SELLING HERCULES EXPLOSIVE**
- as the **STANDARD** explosive for tunneling
- as the **STANDARD** explosive for metal mining
- as a **FORERUNNER** in the trend to more economical explosives

EXPLOSIVES DEPARTMENT
HERCULES POWDER COMPANY
Incorporated
WILMINGTON • DELAWARE

A-81

Compressors CLEAN ...in this QUARRY!



GENERAL VIEW of material on hand and conveyors at Campbell Limestone Co.'s Greenville, S. C., operations. Trucks, shovels, conveyors, drills, motors . . . all equipment has, for years, been lubricated exclusively with Texaco.

INGERSOLL-RAND Compressors of 900 and 500 cu. ft. capacity furnishing air for rock drills in Campbell Limestone quarry. For years the only lubricant used has been Texaco.

CAMPBELL LIMESTONE COMPANY'S I-R Compressors are delivering air at full pressure for this big quarry.

For years the oil used to lubricate these compressors has been *TEXACO ALGOL OIL.*

Texaco Alcaid, Algol and *Ursa Oils* keep compressors clean, valves active, rings free. These oils are highly stable, resisting gum, sludge and carbon formation. Trained lubrication engineers will gladly cooperate in making savings with *Texaco Alcaid, Algol* or *Ursa Oils* in your compressors. Phone the nearest of more than 2300 Texaco warehousing points in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

ROCK DRILLS

TEXACO'S INTERESTING BOOKLET on Rock Drills, their care and lubrication. 36 pages of valuable information. Full of illustrations. It's yours for the asking.

TEXACO DEALERS INVITE YOU to enjoy Fred Allen in the new full-hour program of The Texaco Star Theatre . . . with Kenny Baker, Al Goodman's Orchestra and a great cast. Every Wednesday Night, Columbia Network. 9:00 E.S.T., 8:00 C.S.T., 10:00 M.S.T., 9:00 P.S.T.

TEXACO

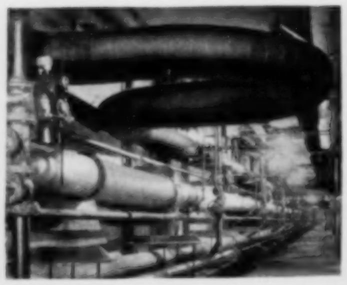
TEXACO ALCAID, ALGOL, AND URSA OILS

We look
upon your piping job
with 9 Eyes!
5

The nine divisions of Blaw-Knox Company are the combined facilities and resources of Power Piping Division . . . in metallurgy, annealing and stress relieving, bending, welding, fabricating, research, highly developed procedures, scientific control.

Together these plants, special machinery, laboratories and highly skilled personnel, provide a complete service that insures the best possible results without necessity for subletting contracts.

Thus many eyes contemplate your piping job when Power Piping Division serves you.



Results obtained by Power Piping Division engineers in shop fabricating and installing complex tunnel piping system in confined space.

All welded piping installation with carbon-moly steel valves welded to regular carbon steel pipe. A typical Power Piping Division job.

Ask For
NEW BOOK

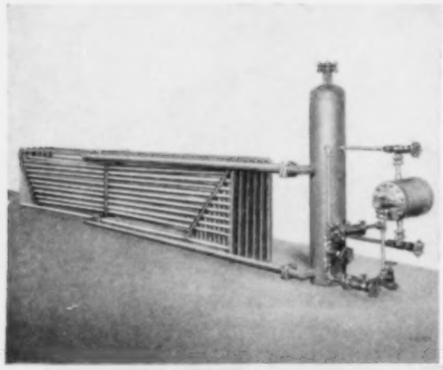
FLEX-ANAL CHARTS, by E. A. Wert and S. Smith, sponsored by Blaw-Knox Company—Power Piping Division. With this book engineers can figure stresses in high pressure—high temperature piping systems by means of graphs and highly-simplified formulae. Book is priced at $3 but will be SENT FREE to engineers who ask for it on business letterheads.

BLAW-KNOX COMPANY
POWER PIPING DIVISION

1525 PENNSYLVANIA AVENUE · PITTSBURGH, PA.

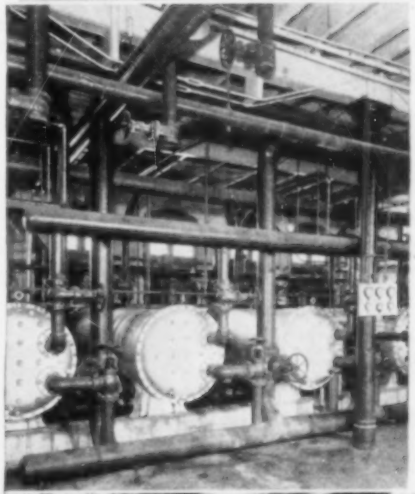
Vogt

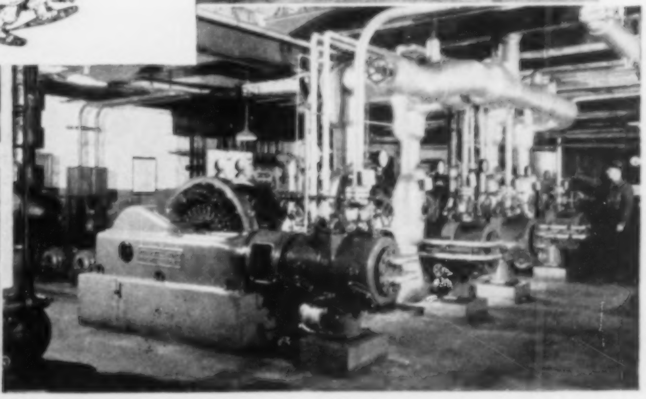
ICE MAKING and REFRIGERATING Equipment



FOR
ICE MAKING PLANTS
COLD STORAGE WAREHOUSES
PACKING PLANTS
DAIRIES
BREWERIES
OIL REFINERIES
CHEMICAL PLANTS
AND
RELATED INDUSTRIES
THAT REQUIRE
COMPLETE PLANT OR
PARTS FOR COMPRESSION
OR ABSORPTION
REFRIGERATION
SYSTEMS

Vogt
FOR BETTER REFRIGERATION



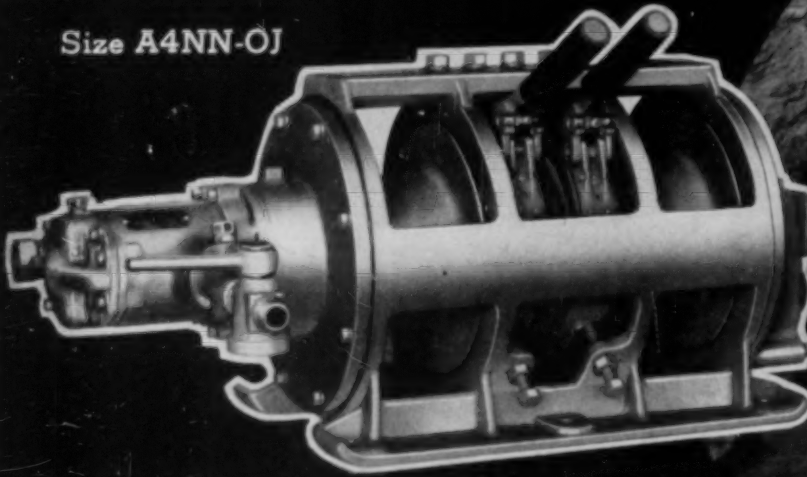


New York Philadelphia Cleveland Chicago Cincinnati St. Louis Dallas

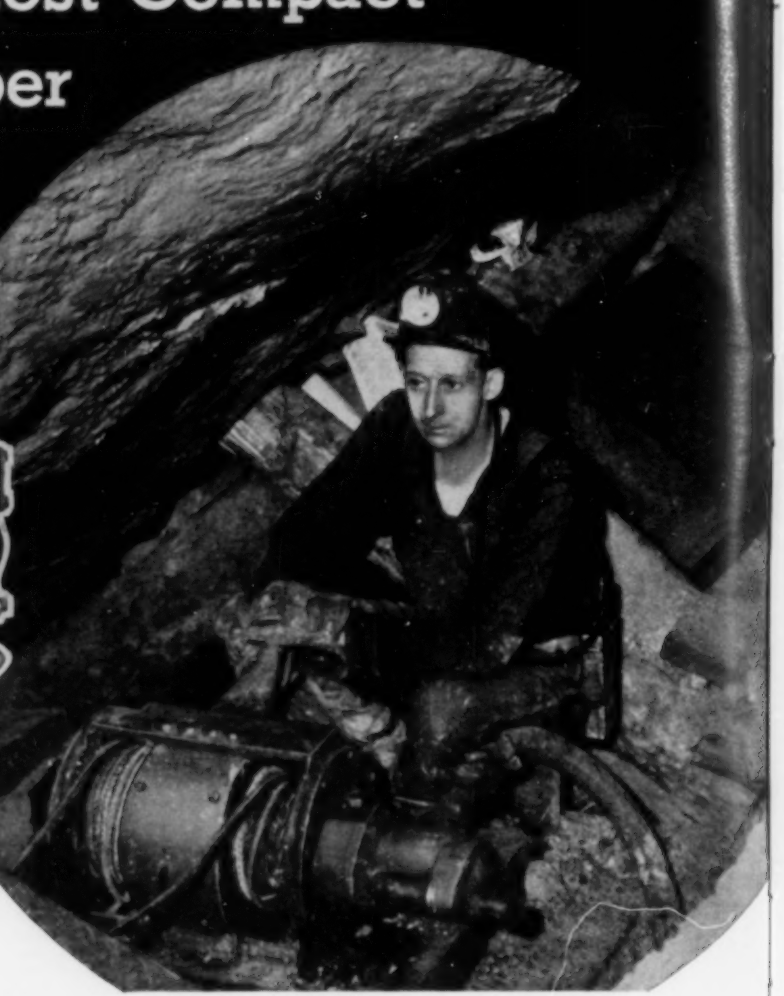
HENRY VOGT MACHINE CO. Inc., LOUISVILLE, KY.

The Lightest and Most Compact Double-Drum Scraper Hoist Ever Built

Size A4NN-OJ



Air-Motor Driven "O" Frame Hoist.



The Size A4NN-OJ working in an inclined stull-timbered stope of a lead-zinc mine.

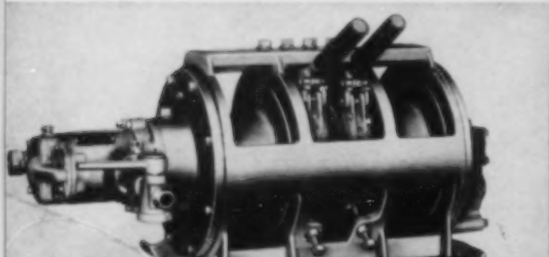
A Real Money Maker...

- Air or Electric drive.
- Air Unit weighs only 250 lbs. (without guides). Can be carried by two men.
- Cable pull 650 to 1000 lbs. Cable speed 125 to 150 ft. per minute.
- Will pass through an opening 13″ x 15″.

This New "Featherweight" hoist was designed especially for small scraping jobs in thin, narrow veins or stopes, irregular veins, crosscuts; for spreading waste, development work, etc.

It will pay you to investigate this remarkable hoist. There's always an experienced I-R hoist man ready to help you with your problems.

Can be mounted on drill column and arm.



Two men can carry it.

Operating in a square set stope.

Atlanta
Birmingham
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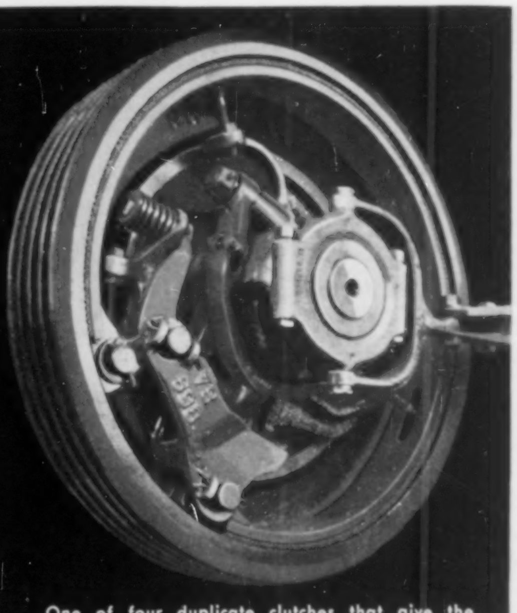
CRANES
that handle with a smooth, firm grip



One of four duplicate clutches that give the ¾-yard 20-B its famous direct-action control.

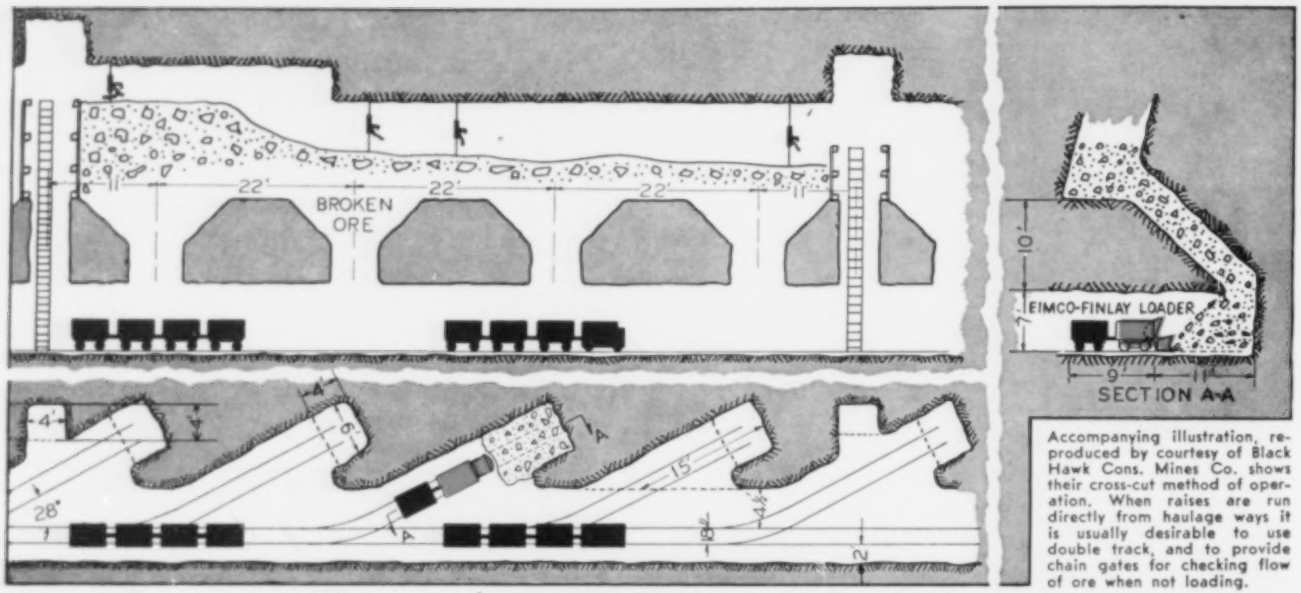
SPEED of operation and accuracy of control on Bucyrus-Erie cranes are, in part, due to the care used in designing the extra large area clutches and brakes so that they take hold uniformly with a smooth firm grip. They keep cool in operation, hold accurate adjustments for long periods. The special linings grip firmly without chattering, and have exceptionally long life.

Provision is made for accurate and convenient adjustment, through a single adjustment unit. Adjustments once made "stay put" on Bucyrus-Erie cranes. The operator always has the feel of the machine and the sure confidence in the clutch and brake action that permits fast, steady operation of the machine at all times.

We believe any shovel, dragline, or crane operator familiar with our modern designs will tell you that Bucyrus-Erie has the smoothest, easiest operating, most dependable clutch and brake system offered by any manufacturer in this field. Find out about the savings fast-moving Bucyrus-Eries offer in your material handling.

Bucyrus·Erie

SOUTH MILWAUKEE, WISCONSIN



Accompanying illustration, reproduced by courtesy of Black Hawk Cons. Mines Co. shows their cross-cut method of operation. When raises are run directly from haulage ways it is usually desirable to use double track, and to provide chain gates for checking flow of ore when not loading.

Save time and money by loading out of shrinkage stopes *with* EIMCO-FINLAY LOADERS

In many mines big savings are now being achieved by allowing ore to run down out of shrinkage stopes onto the floor of cross-cuts or haulage ways, from where it is loaded directly into cars by one or more Eimco-Finlay Loaders. Some of the many advantages secured are listed below:

1 Elimination of the timbering, bins, gates, chutes, grizzlies and sub-levels required for loading directly into cars. These draw-control set-ups are not only expensive to install, but often even more expensive to keep in good condition.

2 Elimination of delay in opening up ore-bodies, heretofore required for installing chutes, gates, grizzlies, etc. By the Eimco method you simply shoot the ore down and start loading it into cars.

3 Larger extraction openings can be used, thereby reducing danger of the ore flow being stopped because of clogging or piping.

4 Less blockholing (secondary blasting) is required. When loading, any pieces to be blockholed can be rolled to one side on the floor of the cross-cut and broken later. Safety is promoted because blockholing is done in a relatively small and confined area.

5 Extraction openings can be filled with rock, to suit the mining operation, and loaded out as desired.

6 Ore can be loaded out much more rapidly and economically. One mine recently reported loading 178 cars in six hours with a Model 12-B Eimco-Finlay Loader.

7 Maintenance cost of stopes, and general overhead expense, is reduced because stopes can be cleaned out much sooner.

8 Danger of injuries, or casualties, to men loosening ore in extraction openings is very largely eliminated.

Other money-saving methods of using Eimco-Finlay Loaders in modern mines and tunnels are illustrated and described in our new 36-page bulletin No. 105. Write today for your free copy.

THE EIMCO CORPORATION

SALT LAKE CITY, UTAH, U.S.A.

NEW YORK, 330 W. 42nd St.
CHICAGO, 333 No. Michigan Ave.
EL PASO, Mills Building
SACRAMENTO, 1217 7th St

INGERSOLL-RAND CO., LTD.
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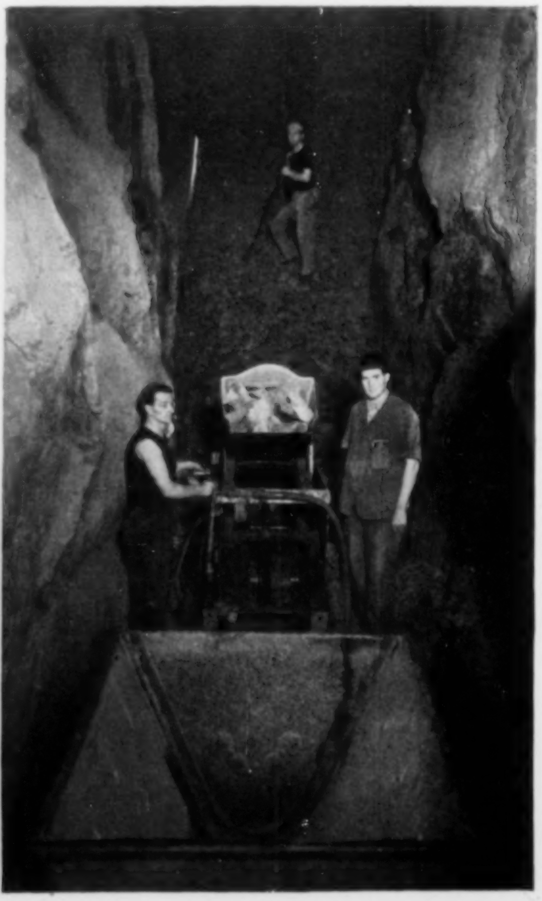
*** BRITISH MIN. SUP. CO. (PTY.), LTD.**
Troye House, Johannesburg, S. A.
*** HODGSON & CRANSTON**
Boulder Road, Kalgoorlie, Australia
CLYDE ENGINEERING LTD.
Wellington, New Zealand
*** MINE EQUIPMENT COMPANY LTD.**
Kirkland Lake, Ontario, Canada

*** B. C. EQUIPMENT CO., LTD.**
551 Howe St., Vancouver, B. C.
*** MARSMAN TRADING CORPORATION**
Manila and Baguio, Philippine Is.
AMERICAN TRADING COMPANY
Tokyo, Japan
INTERNATIONAL MACHINERY CO.
Rio de Janeiro, Santiago and Antofagasta

Replacement parts carried in stock by agents indicated with asterisks.

Loading out of shrinkage stope with an Eimco-Finlay Loader at the Lake View and Star Mine, Kalgoorlie, Australia.



MATCHED FOR BETTER PERFORMANCE

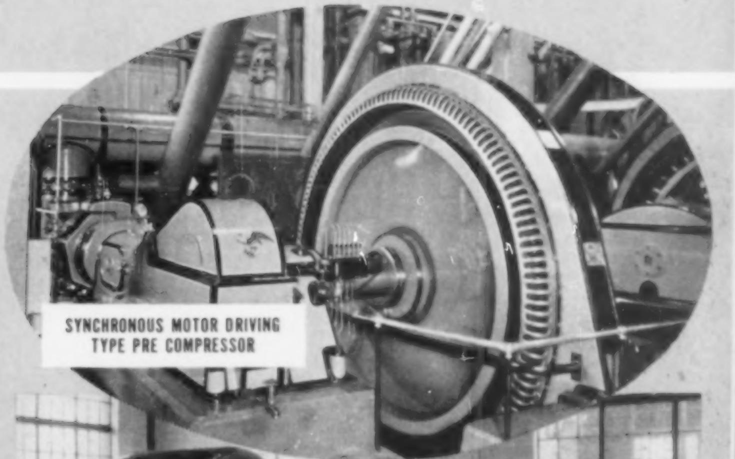
Ingersoll-Rand compressors, powered by Westinghouse, give top-notch performance on any application from garage compressors to blast furnace blowers.

It's teamwork that does it. Westinghouse engineers work side by side with the compressor manufacturer to provide motor or turbine drives which match the performance of the compressor.

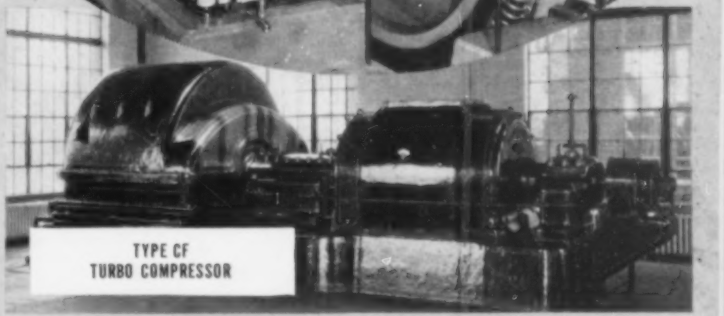
This is true, too, for any type of motor or turbine driven equipment. You will get better performance be specifying Westinghouse.

WESTINGHOUSE ELECTRIC & MFG. CO.
EAST PITTSBURGH, PA.

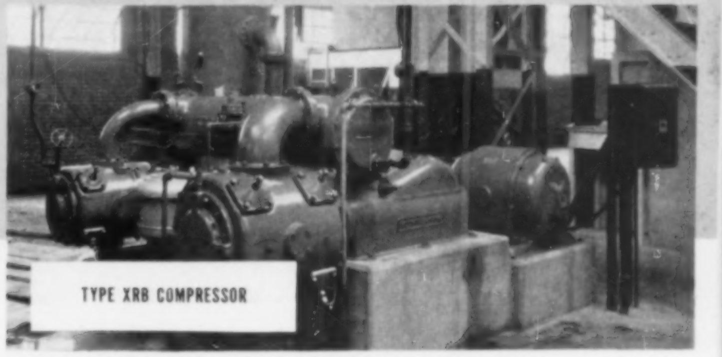
Tune in "Musical Americana," N. B. C. Network, Coast-to-Coast, every Tuesday evening.



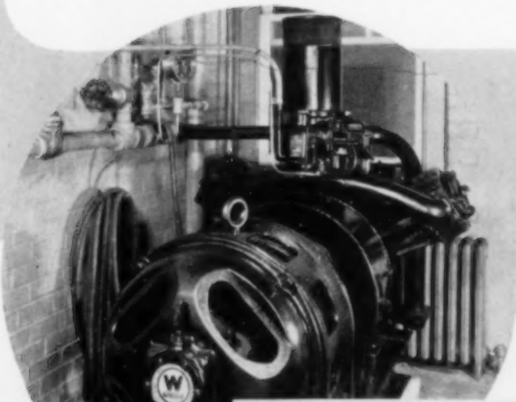
SYNCHRONOUS MOTOR DRIVING TYPE PRE COMPRESSOR



TYPE CF TURBO COMPRESSOR

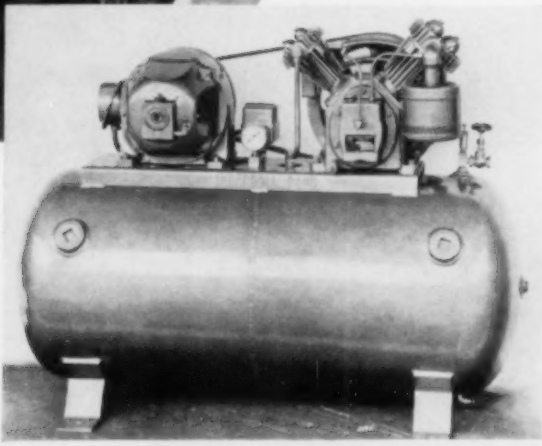


TYPE XRB COMPRESSOR



J-94367

TYPE 40 MOTORCOMPRESSOR



TYPE 30 COMPRESSOR FOR SERVICE STATIONS

PUT THIS EXPERIENCE TO WORK FOR YOU

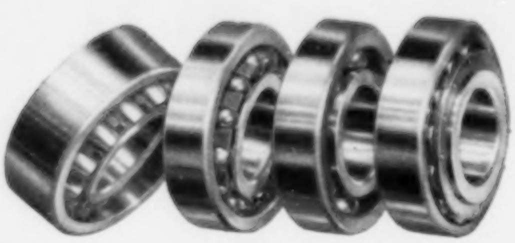
For 50 years, Westinghouse has worked side by side with industry to provide drives that stand up in service and are properly co-ordinated with mechanical equipment. Westinghouse engineers are thoroughly familiar with compressor problems—and they are ready to co-operate with you on any job. You can obtain their assistance through your local Westinghouse office.

Westinghouse

WESTINGHOUSE ELECTRIC

ELECTRICAL PARTNER OF INDUSTRY

THE RIGHT TIME



TO CHECK BEARINGS IS BEFORE YOU BUILD

SKF
Puts the
Right Bearing
in the
Right Place

WHEN THIS H-3 Calyx Drill was only a blueprint, designers knew its points of greatest vulnerability would be the places where Friction could do its worst to wear down, tear down, break down. So they took no chances, and selected SKF Bearings for the input shaft of forward and reverse transmission and for the spindle.

BUILT BY INGERSOLL-RAND

On railroad journals . . . on back-up rolls . . . on the toughest jobs in every field of Industry, SKF's have proved their ability to check Friction—to replace Friction's costly drag with dependable performance.

Back of every SKF Bearing is the sort of engineering support that can only come from an organization of vast resources. Back of it are laboratories that put SKF Bearings to tests that are seldom encountered in service. Let SKF solve *your* bearing problems, too.
4655

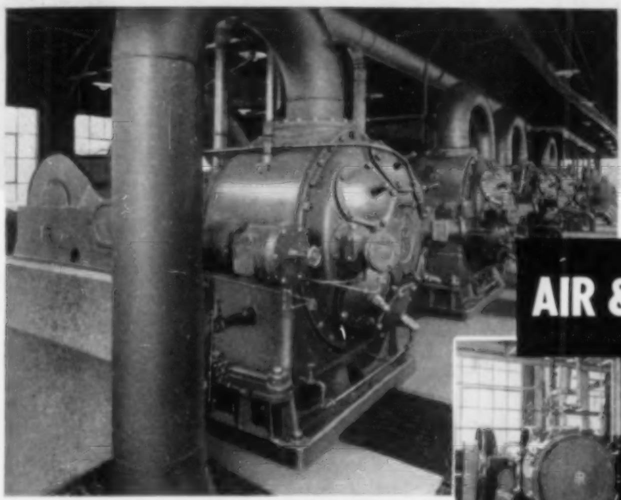
SKF INDUSTRIES, INC., PHILADELPHIA, PA.

SKF

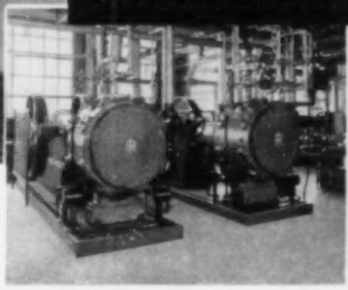
BALL & ROLLER BEARINGS

Ingersoll-Rand Compressors and Pumps are used in every Major Process at SHELL'S WOOD RIVER PLANT

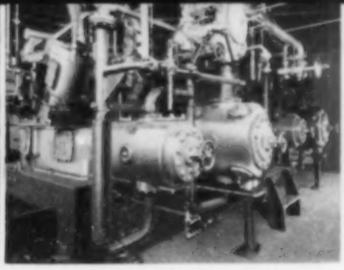
AIR & GAS COMPRESSORS & VACUUM PUMPS



The main compressor room in the Wood River, Ill., plant of the Shell Oil Co. contains five I-R direct-connected electric-driven gas compressors totalling 2150 hp.



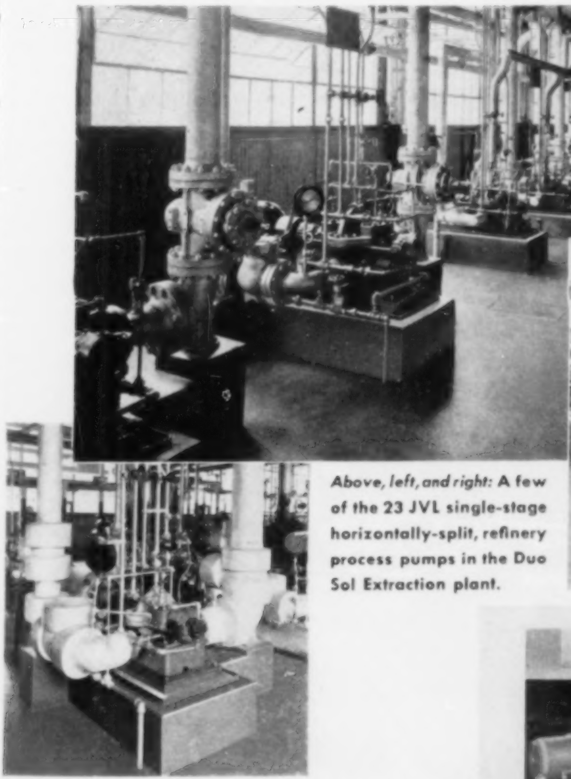
Two steam-driven type FS two-stage vacuum pumps in the Duo Sol Extraction plant.

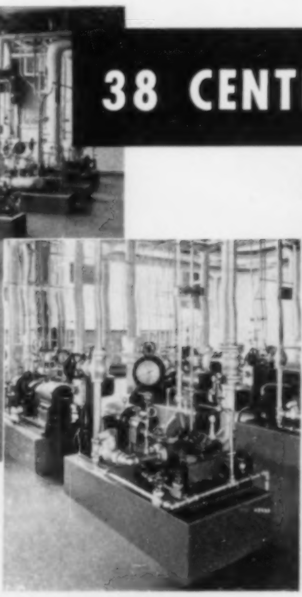


The two 150-hp XVG gas-engine-driven compressors shown above handle gas at varying pressures.

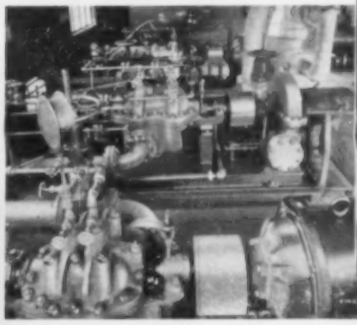
Compressed air for plant use is supplied by this 700-hp PRE duplex electric-driven compressor.

38 CENTRIFUGAL PUMPS

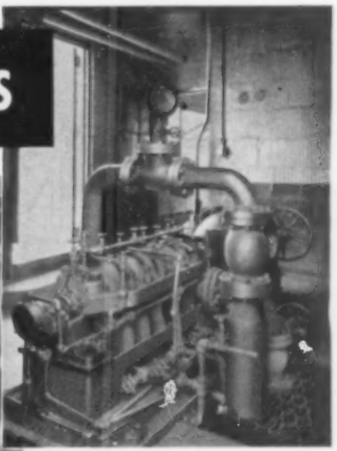




Above, left, and right: A few of the 23 JVL single-stage horizontally-split, refinery process pumps in the Duo Sol Extraction plant.

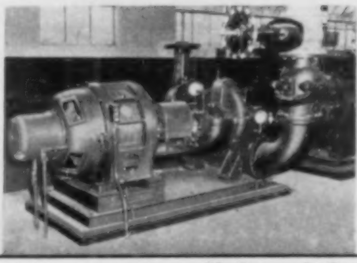


One 4-in. turbine-driven, together with one 3-in. and one 4-in. motor-driven Class GT two-stage pumps are used in reboiler service.



This motor-driven 2-in. Class NT six-stage pump is operating at 500-lb pressure, stabilizer plant charging service.

PLANT WATER SUPPLY



Left: One of the three motor-driven Class ALV single-stage double-suction pumps used for main water supply.

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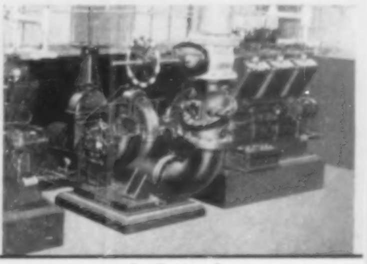

Two Class ALV water supply pumps, gasoline-engine-driven.

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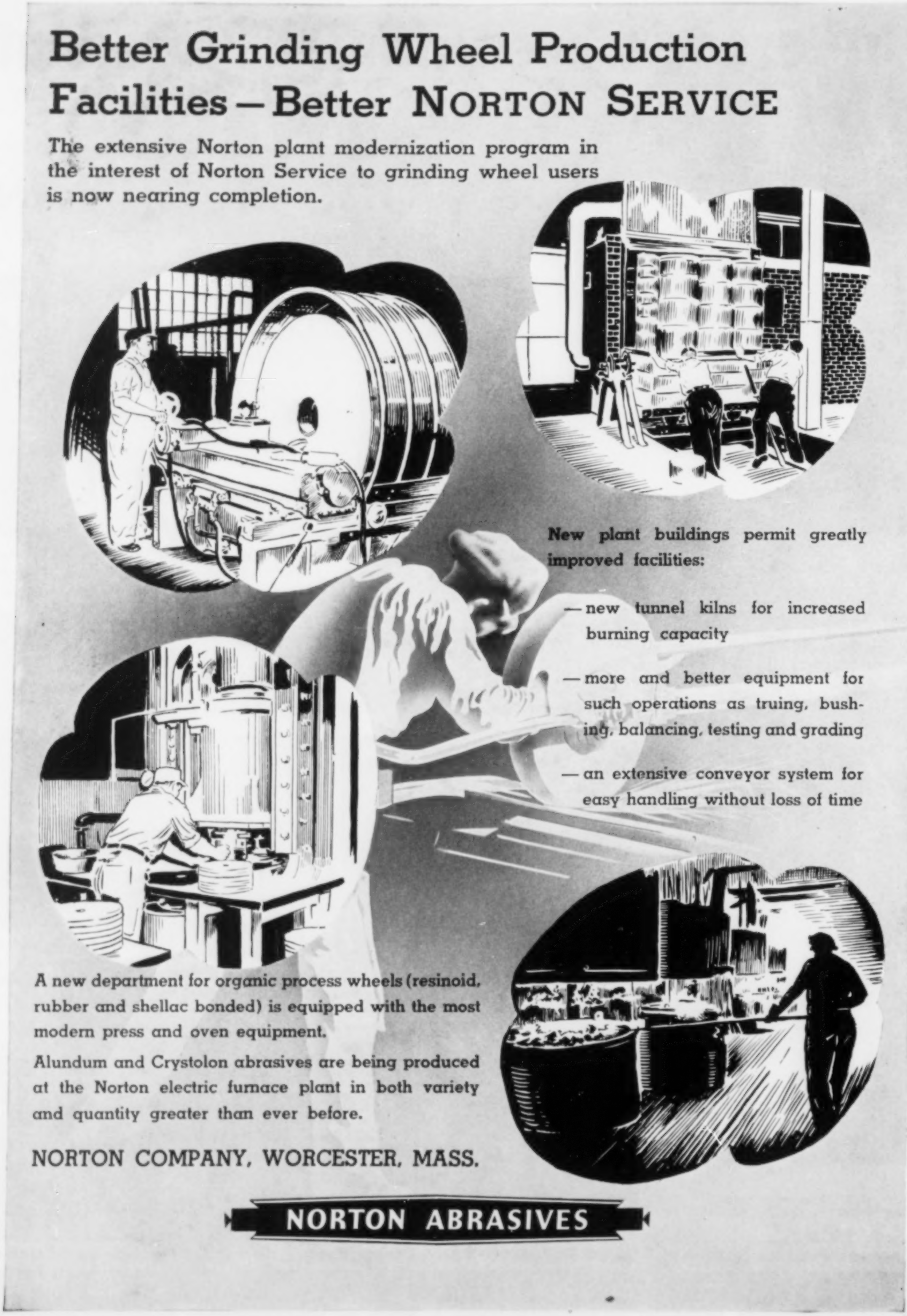

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ON THE COVER

OUR cover picture shows an oyster fleet returning at sunset to the docks at Bivalve, N.J., with a day's yield from the beds in the estuary of the Delaware River. From September through April, 60,000 persons busy themselves in the oyster trade of the United States.

•

IN THIS ISSUE

SPRAWLING across nearly 10 miles of hilly terrain, the world's longest belt conveyor is moving concrete aggregates to Shasta Dam, near Redding, Calif. At the height of concreting operations it will carry the equivalent of 440 carloads a day. Details of this remarkable transportation system are given in our leading article.

•

HOP growing once brought prosperity to a large area of New York State. Although it has long since vanished, it has left its mark upon the architecture of the countryside, as related by Roy E. McFee.

•

FOR certain types of mine development work, the Phelps Dodge Corporation has found large-diameter Calyx core drills to be safer and more satisfactory than conventional drilling and blasting methods. Experiences with a 48-inch drill in the United Verde Mine are summarized by Chief Engineer C. E. Mills.

•

MOBILE, Ala., is the first city in the South to build a subaqueous vehicular tunnel. It is named for the late John H. Bankhead, former United States Senator and long an exponent of good highways. He was the father of William B. Bankhead, late Speaker of the House of Representatives, who died last month.

Compressed Air Magazine

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Volume 45 **OCTOBER, 1940** Number 10

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EDITORIAL CONTENTS

Shasta Dam Conveyor-Belt System—*Henry W. Young* . . . 6249
A Golden Age of Hops—*Roy E. McFee* . . . 6254
Calyx Core Drilling at United Verde Mine—*C. E. Mills* . . . 6258
Mobile Builds an Under-River Highway—*R. G. Skerrett* . . . 6262
Mine Pumping Now and in 1834 . . . 6267
Why a Flask of Mercury Weighs 76 Pounds . . . 6267
Editorials—Future Aluminum Supply—Safer Night Driving . . . 6268
Drill Runners Like New Jackhamer Mounting . . . 6269
Metallic Lubricant for X-Ray Tubes . . . 6269
Gasoline-Hose Nozzle . . . 6269
Window Scaffold . . . 6269
Industrial Notes . . . 6270

ADVERTISING INDEX

Air-Maze Corporation . . . 21
American Air Filter Co., Inc. . . . 20
American Brass Company, The . . . 19
Bethlehem Steel Company . . . 28
Blaw-Knox Company . . . 6
Bucyrus-Erie Company . . . 9
Compressed Air Magazine Co. . . . 29
Conrader Company, R. . . . 27
Cook Mfg. Co., Inc., C. Lee, . . . 15
Coppus Engineering Corp. . . 2d Cover
Dayton Rubber Mfg. Co., The . . . 24
Elastic Stop Nut Corp. . . . 21
Emico Corporation, The . . . 10
Garlock Packing Co., The . . . 30
Hercules Powder Co., Inc. . . . 4
Ingersoll-Rand Co., . . . 8-13-16-23-31
Jarecki Manufacturing Co. . . . 30
Madison-Kipp Corporation . . . 18
Maxim Silencer Co., The . . . 21
National Forge and Ordnance Co . . 27
New Jersey Meter Company . . . 29
Norton Company . . . 14
Rotor Tool Company . . . 17
SKF Industries, Inc. . . . 12
Socony-Vacuum Oil Co., Inc. . . . 25-26
Square D Company . . . 27
Staynew Filter Corporation . . . 3
Texas Company, The . . . 5
Timken Roller Bearing Co., The . . . 4th Cover
Toledo Pipe Threading Mach. Co. . 27
Twin City Iron Works . . . 3d Cover
Vogt Machine Co., Inc., Henry . . . 7
Wagner Electric Corporation . . . 21
Waukesha Motor Company . . . 22
Westinghouse Elec. & Mfg. Co. . . . 11
Willson Products, Inc. . . . 30

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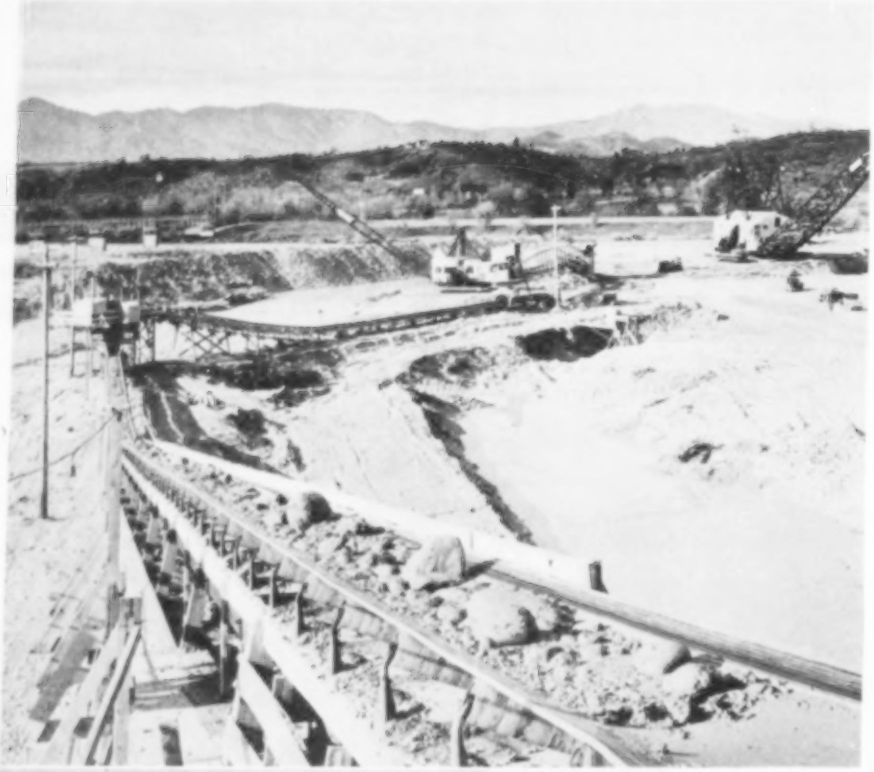
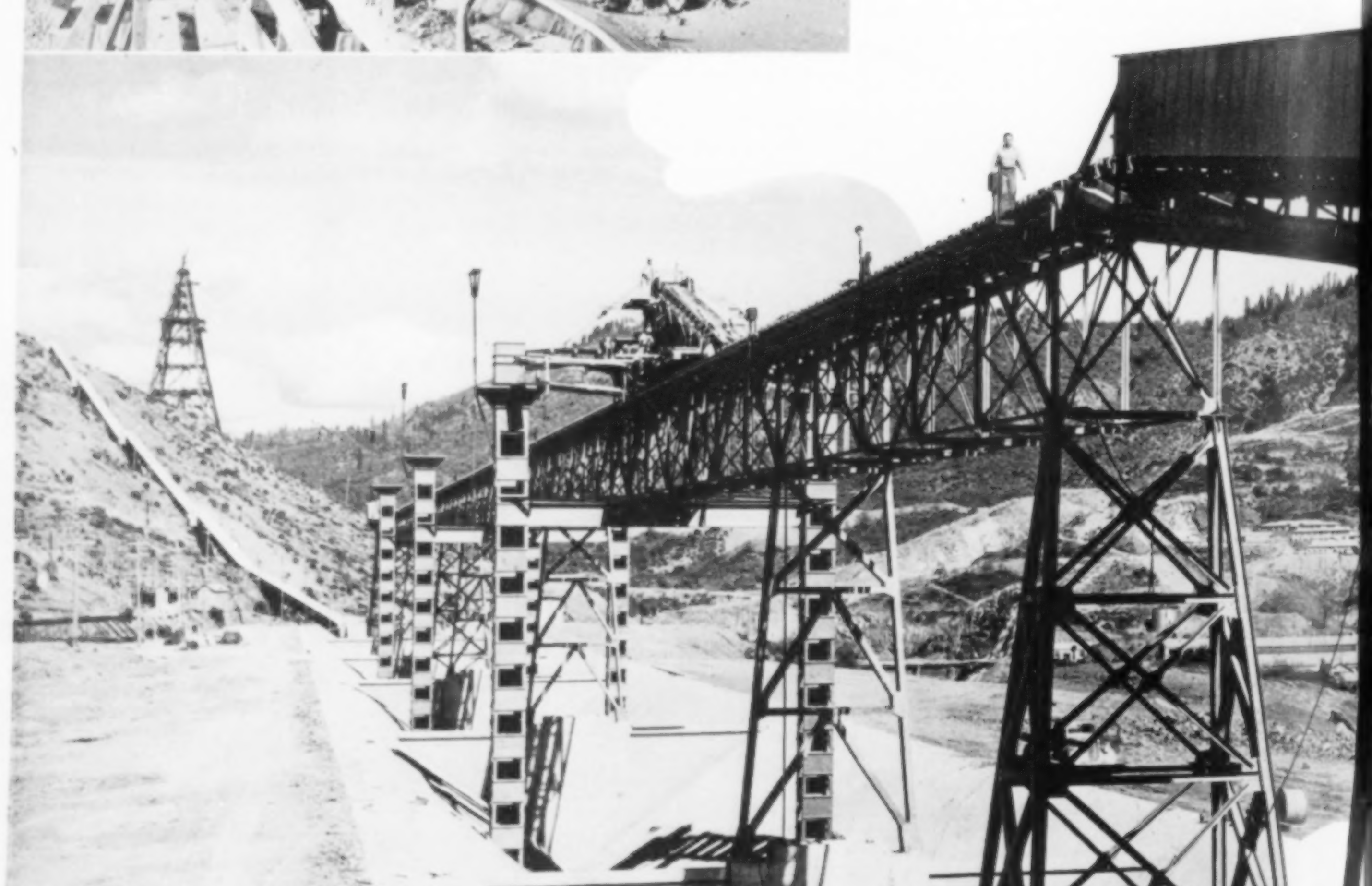
Published by Compressed Air Magazine Company. G. W. Morrison, president; J. F. Kenney, vice-president; F. E. Kutz, secretary-treasurer.
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York, N. Y., L. H. Geyer, representative.
Annual subscription price: domestic, $3.00; foreign, $3.50. Single copies, 35 cents.
Compressed Air Magazine is on file in many libraries and is indexed in Industrial Arts Index



Shasta Dam Conveyor-Belt System

Henry W. Young

Photos, courtesy U. S. Bureau of Reclamation.



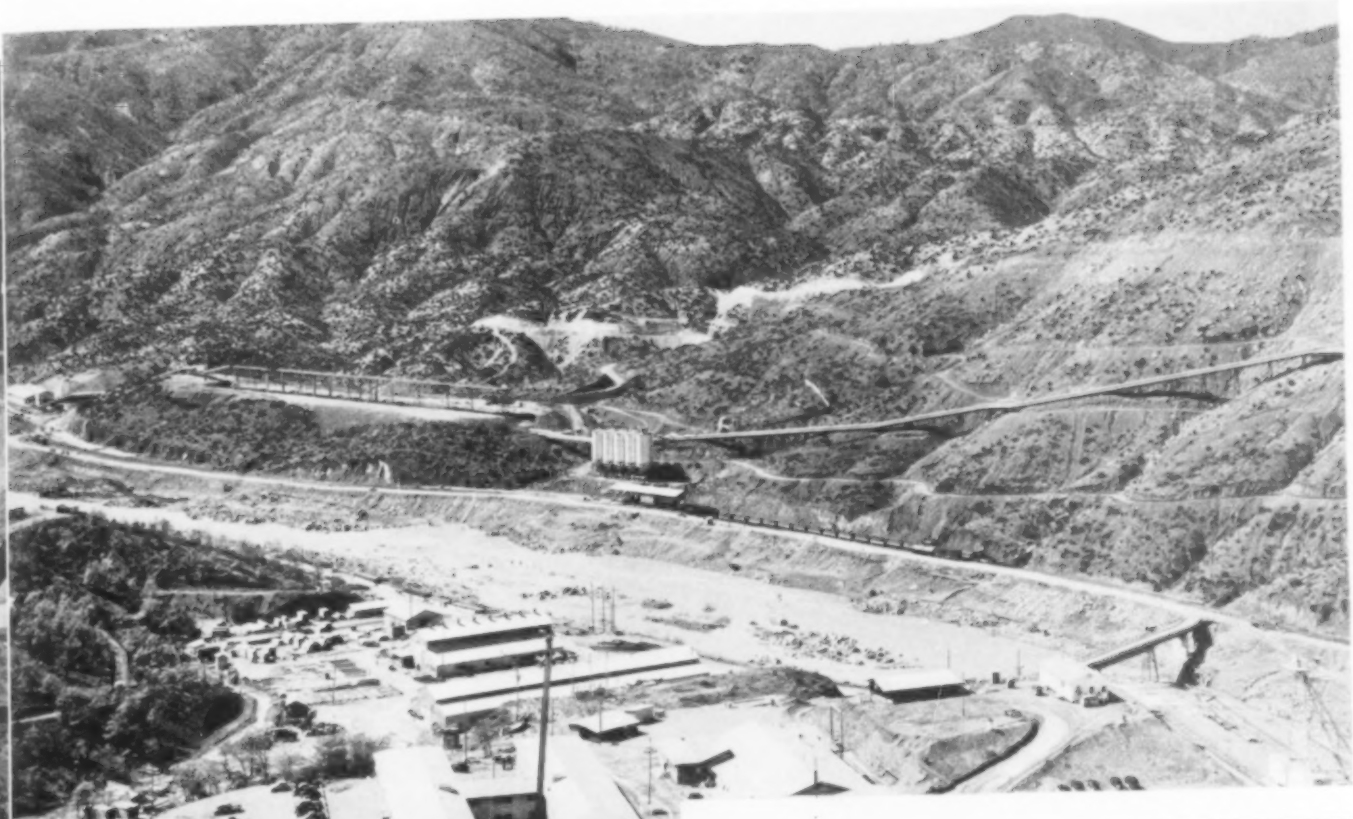
IN THE production and transportation of the concrete aggregates for the construction of the Shasta Dam across the Sacramento River in California, there is being achieved something that in Hollywood parlance would be proclaimed as colossal," although in the conservative language of the engineer it is simply "a bold conception of a large transport problem." Just what this problem is, and the magnitude of it, are matters that involve some statistics that may as well be set down at the beginning.

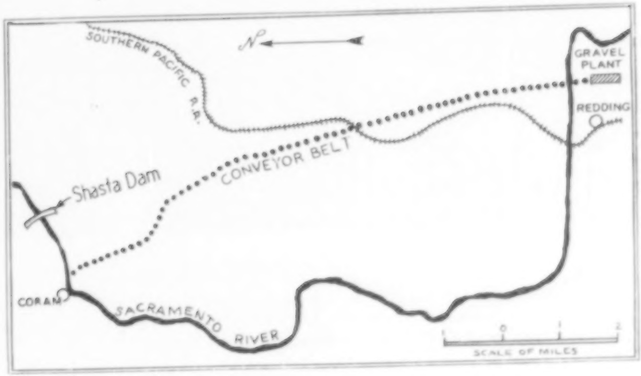
Shasta Dam, the principal feature of the Central Valley Project of the U.S. Bureau of Reclamation, will, upon completion, be the second largest concrete structure of its kind in existence, being exceeded in volume only by the Grand Coulee Dam. In its building there will be used 7,600,000 tons of gravel and 2,800,000 tons of sand—a total of 10,400,000 tons. Sometime in 1942, when concrete placing will reach its peak, the daily requirements will be as high as 16,000 tons of gravel and 6,000 tons of sand.

The work of excavating, preparing, and transporting this great quantity of material is being done by the Columbia Construction Company, Inc., of Oakland, Calif. Already the "migration of the particles" has started over a conveyor belt 9.5 miles long, a system that in length dwarfs anything of this nature ever before attempted. For this job the company will receive $6,047,972, including a change order providing delivery by belt instead of railroad, as first contemplated. As the lowest of five bidders, Columbia was awarded the contract by the Bureau of Reclamation.

Some dams are fortunately situated and some are not as regards suitable gravel deposits in close proximity to their sites. Shasta is in the latter class. In the course of investigations that began in 1936, more than 50 such deposits in five counties in California were considered, and hundreds of drill samples from some 450 exploratory pits were tested in the laboratories of the Bureau of Reclamation. Finally, the choice was narrowed down to two sources, one known as the North Kutras Tract and the other as the Hatch Tract. The latter is 28 miles down the river from the dam site, and two of the five bidders planned to use it. The North Kutras Tract, on which Columbia's bid was based, is located 12 miles downstream from the dam and on the eastern outskirts of the thriving City of Redding, which was named after Maj. Pierson B. Reading, a pioneer of the West. Redding is as near to the spelling as the early map makers got, and so it has remained.

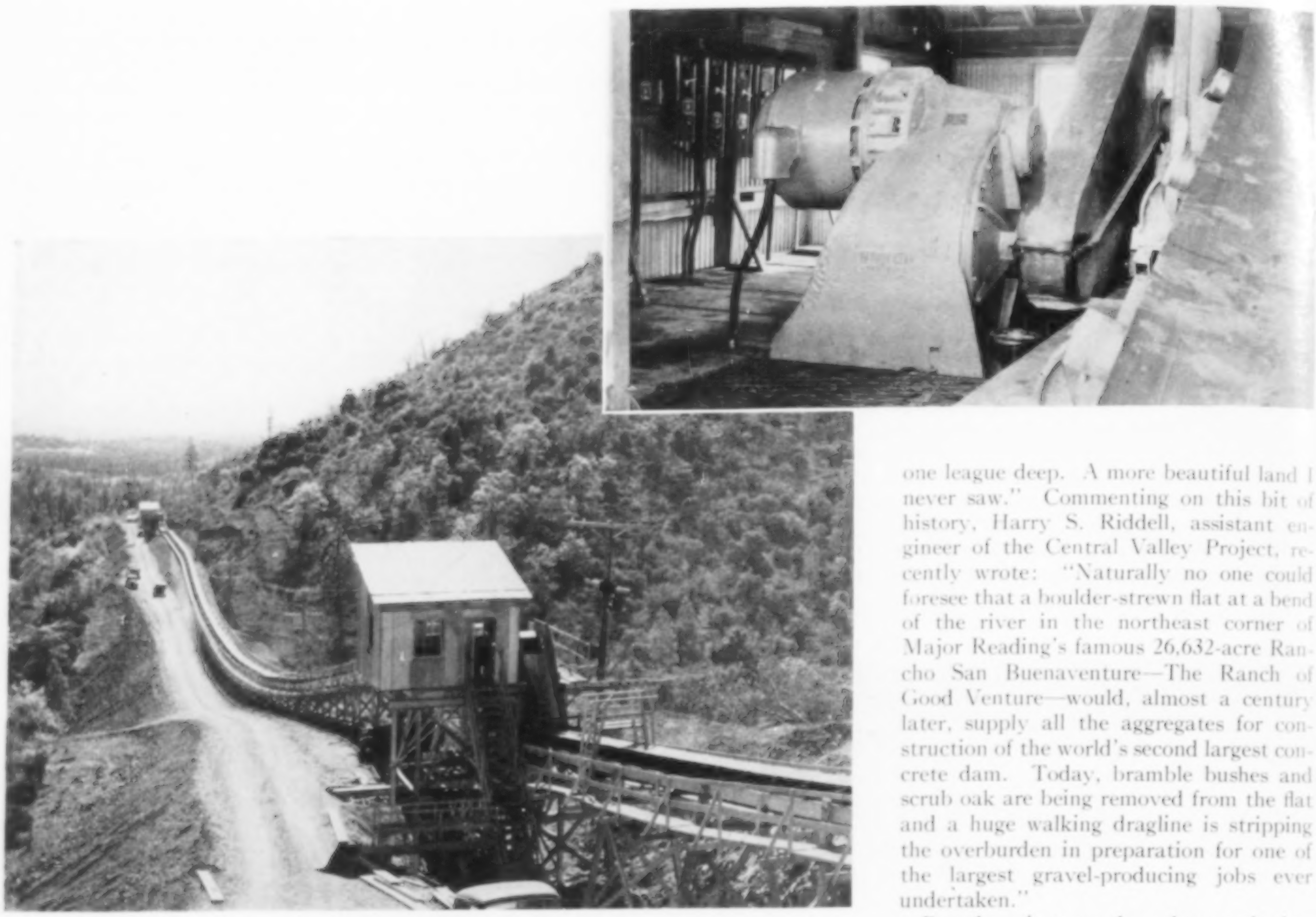
Back in February, 1844, Major Reading wrote a letter from Monterey, then the Mexican capital of California, to his brother, saying: "I have received from the government a large tract of land as a grant. The title is good and secures the land to me forever. The tract is in length five leagues, on the bank of the Sacramento River, and





CONVEYOR ROUTE AND TERMINALS

The picture at the upper left shows the gravel pit near Redding, with two Monighan draglines at work. In the foreground is the belt that carries raw gravel to the treatment plant. The storage bins at Coram, nearly 10 miles from the source of the gravel, are seen at the lower left. At this point, Pacific Constructors, Inc., builders of Shasta Dam, take delivery of the sized aggregates. From Coram, the aggregates are sent up to the dam site over its own conveyor system, which is shown angling up the hillside at the right in the view above. At the center of the picture are ten steel storage silos for cement that have a combined capacity of 50,000 barrels. The drawing shows the general course of the conveyor belt.



CONTROL STATION

A section of the conveyor system, with its 36-inch belt in place. In the foreground is a motor control or transfer station, of which there are 26—one for each flight. At the top is an inside view of one of these stations showing a 200-hp. motor, coupled to reducing gear, that supplies power for one of the flights.

THE CONVEYOR SKELETON

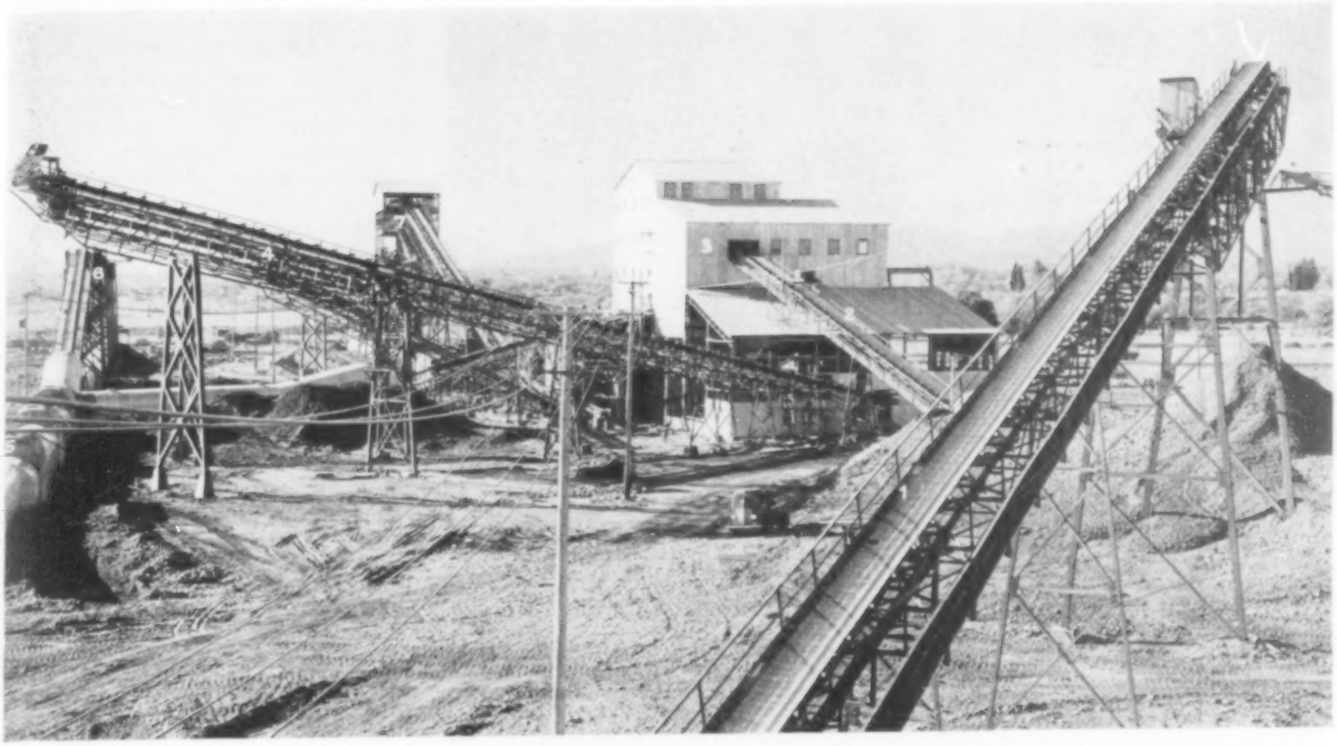
A long section of the line as it looked before the belt was put on. Some of the principal items used in the system are: 16,000 belt idlers, 11 miles of steel shafting, 83,000 roller bearings, and 20 miles of 36-inch, 6-ply belting.

one league deep. A more beautiful land I never saw." Commenting on this bit of history, Harry S. Riddell, assistant engineer of the Central Valley Project, recently wrote: "Naturally no one could foresee that a boulder-strewn flat at a bend of the river in the northeast corner of Major Reading's famous 26,632-acre Rancho San Buenaventure—The Ranch of Good Venture—would, almost a century later, supply all the aggregates for construction of the world's second largest concrete dam. Today, bramble bushes and scrub oak are being removed from the flat and a huge walking dragline is stripping the overburden in preparation for one of the largest gravel-producing jobs ever undertaken."

But there is more than that to the human-interest side of this job of gravel digging: it might turn out to be a gold-dredging undertaking as well. The area involved is in that part of California where gold mining has been carried on more or less continuously since Major Reading's time, including modern dredging operations. The United States has acquired only gravel rights in the selected deposits, not being interested in any mineral that may lie hidden there. However, if the indications warrant it, there is no reason why the property owner and the contractor should not install gold-recovery equipment in connection with the gravel-processing plant, as has been done in supplying aggregates for another dam in California.

Excavation of the sand and gravel is now proceeding with a Monighan dragline with a 10-cubic-yard scraper which scoops up 13 tons at each throw. A smaller Monighan, with a 5-cubic-yard scraper, does the stripping and also assists the larger machine, both delivering to a belt conveyor of the pendulum type with a skid-mounted hopper. From the pendulum conveyor, all but the over-size material passes to a stock pile, which has a live storage capacity of 8,200 cubic yards. The other so-called conversion rock is reduced by a jaw crusher and put into raw-stock storage.

As will be seen by the general view of the plant, it consists of a very imposing group



WHERE AGGREGATES ARE PROCESSED

The raw gravel is put through this mill for classification into the various products, each of which is then carried to the dam site. The belt conveyors *1* and *2* lead from raw-storage piles to the mill *3*, where the material is washed and screened. Processed sand is moved by conveyors *4* to stock piles overlying a recovery tunnel, *5*, from which the main sand conveyor, *6*, runs to a sand-storage pile at the far end of the plant. Coarse gravel coming from the mill is delivered to a classifying tower, 7, where it is separated into four sizes that are distributed to individual storage piles.

of buildings and equipment. The long conveyor in the foreground leads from the stock pile up to the main mill building where the aggregates are processed; and fanning out from the latter are the conveyors which carry the classified materials, each to its own stock pile. Four sizes of gravel are produced. Coming from the raw-stock pile by way of a 42-inch belt, everything larger than 3/16 inch is scalped off to a scrubbing trommel, from which it is fed by a 36-inch belt to four classifying screens that grade it into 3 to 6, 1½ to 3, ¾ to 1½, and 3/16 to ¾ sizes. These are carried away by other belt conveyors to separate stock piles, each with a capacity of approximately 500 tons.

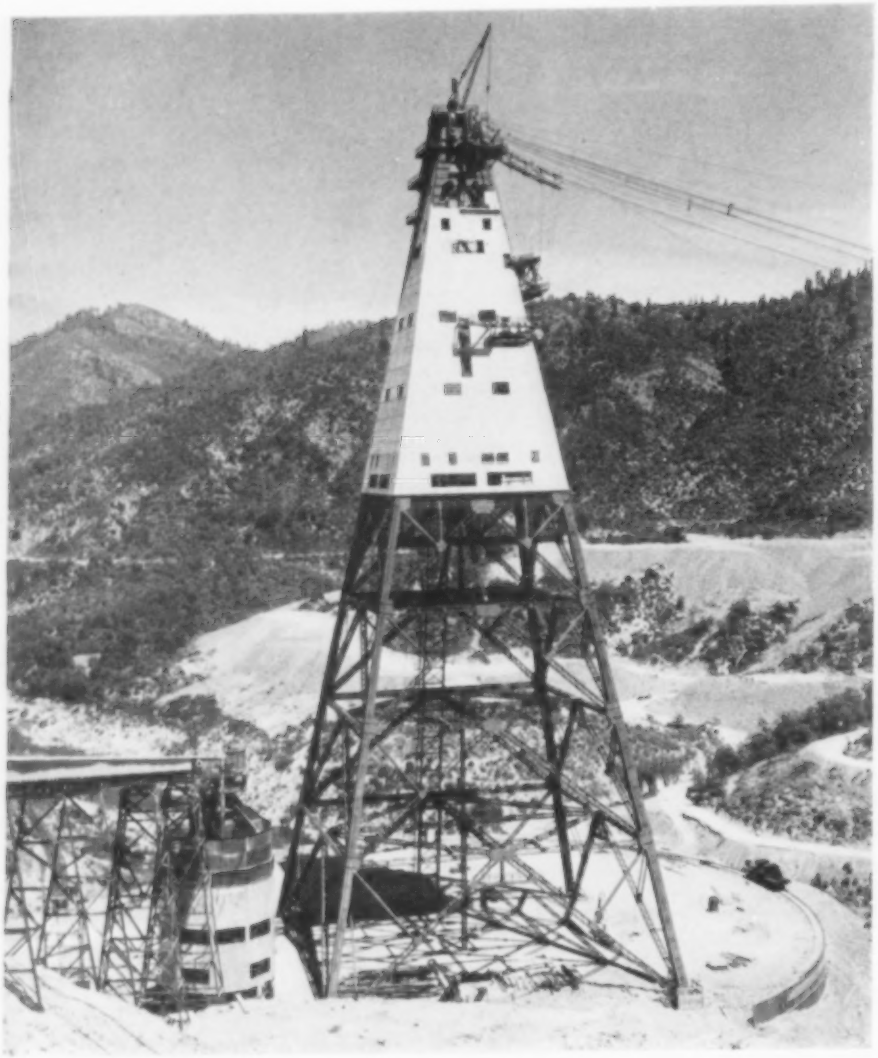
But the material as it comes from the deposit naturally does not supply all the wanted grades in the right proportions. Therefore, when there is a deficiency in any size, the needed quantity is obtained by returning some of the larger sizes to two cone crushers where they are reduced to -⅜-inch crushed rock which can be ground up in a rod mill. In addition, some of the 3/16- to ⅜-inch gravel leaving the trommel is screened out and sent to a balanced-stock pile from which it can be delivered to the rod mill and converted into sand.

Acceptable sand is also produced from the 3/16-inch residue from the screens, the contained deleterious scale and fines being eliminated by feeding it through a differential slug mill the output of which flows to a 20-foot hydroseparator. The underflow from the latter, which contains the undesirable matter, passes to a rake classifier which takes out the coarse sand, while the overflow goes to two other rake classifiers which remove the intermediate and fine sand, respectively. What is left is silt, and this is wasted. Manufactured sand is handled similarly, passing through a smaller hydroseparator and then to the same three classifiers. Each of the three sizes of processed sand is sent to a storage pile having a capacity of 2,250 tons.

When all the gravel and sand have been thus classified, and the several sizes are reposing in their separate stock piles, the aggregates are nearly ready for their journey to the dam by way of the big belt conveyor. Weight-controlled feeders take the sand from the piles and, combined in the proportions specified, deliver it to a 30-inch belt, which carries it to a live storage pile of some 30,000 tons capacity. Both the blended sand and the gravel pass over automatic scales before they are delivered to the big belt.

So far, it has been merely a matter of excavating, washing, and classifying. But even in a sand and gravel "laundry" such as this, compressed air has certain important functions to perform. Air tools are required for maintenance, and air is needed for cleaning motors, screens, and other equipment, for dust is present everywhere in large quantities. It is also used for the operation of various control gates. The air for these varied purposes is supplied by a 75-M Motorcompressor that was originally employed by the Columbia Construction Company in drilling rock and in doing other work at the time the conveyor was in process of construction. This machine is supplemented by a smaller unit, a Type 30, that provides air exclusively for the operation of the gate which controls the flow of sand or gravel to the big belt. In this way the latter is always assured a uniform load, which is of considerable importance from the standpoint of maintenance. The Type 30 is installed at a point near the conveyor trestle where the first flight takes off and crosses the Sacramento River.

Up hill and down dale—twice across the Sacramento, twice across the Southern Pacific Railroad, once across U.S. Route 99, and five times across county highways—extends this "bold conception of a transport problem," this world's greatest belt conveyor. It makes the 9.5 miles in 26 flights over its own right of way. The main crossings, two of the county-road crossings, and the two terminal structures are built of steel; but for most of its length the conveyor follows the contours of the ground over which it travels and rests on wooden trestles 4 feet 6 inches high, the greatest



HEAD TOWER OF CABLEWAY AT DAM

This 460-foot-high structure serves as the head tower for the seven aerial cableways that are being used to deposit concrete for Shasta Dam. Each cableway has its own tail tower moving on a radial track. Three of the cableways are each more than half a mile long. At the left of the tower is the concrete mixing plant. It delivers concrete to 8-cubic-yard buckets on cars that travel around a circular railroad track from which they are picked up by one of the cableways and transported to the point of deposition.

elevation reached being 64 feet. Some excavating and filling in had to be done so as not to exceed the maximum permissible grade, to avoid vertical curves less than 140 feet long, and to keep down construction costs. This work involved the removal of 130,000 cubic yards of material, of which 8,000 cubic yards was rock.

The flights or belts vary in length from 853 to 3,414 feet and are separated by transfer stations. At these the rear belt dumps the material a distance of 10 feet on to the belt immediately ahead through a partly covered chute that is designed to transfer the load with as little interruption and breakage as possible. To absorb the shock and to lessen wear, there are two troughing rolls, equipped with a number of pneumatic tires, under each chute outlet; and the dust caused by the falling material is laid by water sprays served by a line that extends the length of the belt. It is also paralleled by a service road lighted with sodium-vapor lamps and by a telephone system interconnected with a central broadcasting station that permits three radio-equipped maintenance trucks to communicate with any of the drive stations on the conveyor.

All flights are operated by 200-hp. motors, with the exception of the last one which has a 75-hp. motor. At the downhill end of the system—Flights 23 to 26, inclusive—where there are grades as steep as 25 per cent, the motors used are of the regenerative type. From the summit on down to the terminal, the loaded belt has tremendous kinetic energy, and this is utilized to run the motors as generators, thus developing electric current that helps the other flights to reach the maximum elevation of 1,350 feet, representing a climb of 853 feet in 8 miles. The delivery point at Coram is at Elevation 652. Power for the motors is transmitted over a 60-kv. line leading from a junction at the gravel plant at Redding to two substations alongside the conveyor, where it is stepped down to 4-kv. and carried by wire direct to each drive station.

Those to whom facts and figures appeal will be interested in the following data and list of parts that were used in constructing the great belt: Chain belt idlers, 16,000; steel shafting, 11 miles; antifriction roller bearings, 83,000; malleable castings, 50,500; angle iron, 10½ miles; 36-inch, 6-ply Goodyear belting, 20 miles. Into the latter went more than 1,000 bales of cotton and nearly 1,000,000 pounds of rubber. The belt is 36 inches wide and moves at the rate of 550 feet a minute. It transports 1,100 tons of material an hour, the sand and each of the sizes of gravel being handled separately, of course. The traveling time from Redding to Coram, where the materials are delivered to the dam contractor, is 1 hour and 40 minutes.

As the aggregates, one at a time, come in over the long belt, they are discharged into bunkers, as shown in one of the photographs. Coram is approximately half a mile from the dam site, and Pacific Constructors, Inc., has installed its own conveyor-belt system to carry the materials to stock piles from which they can be readily moved to the one mixing plant. Near the Coram bunkers stand ten steel silos, each 23 feet in diameter and 70 feet high, having a combined capacity of approximately 50,000 barrels of cement.

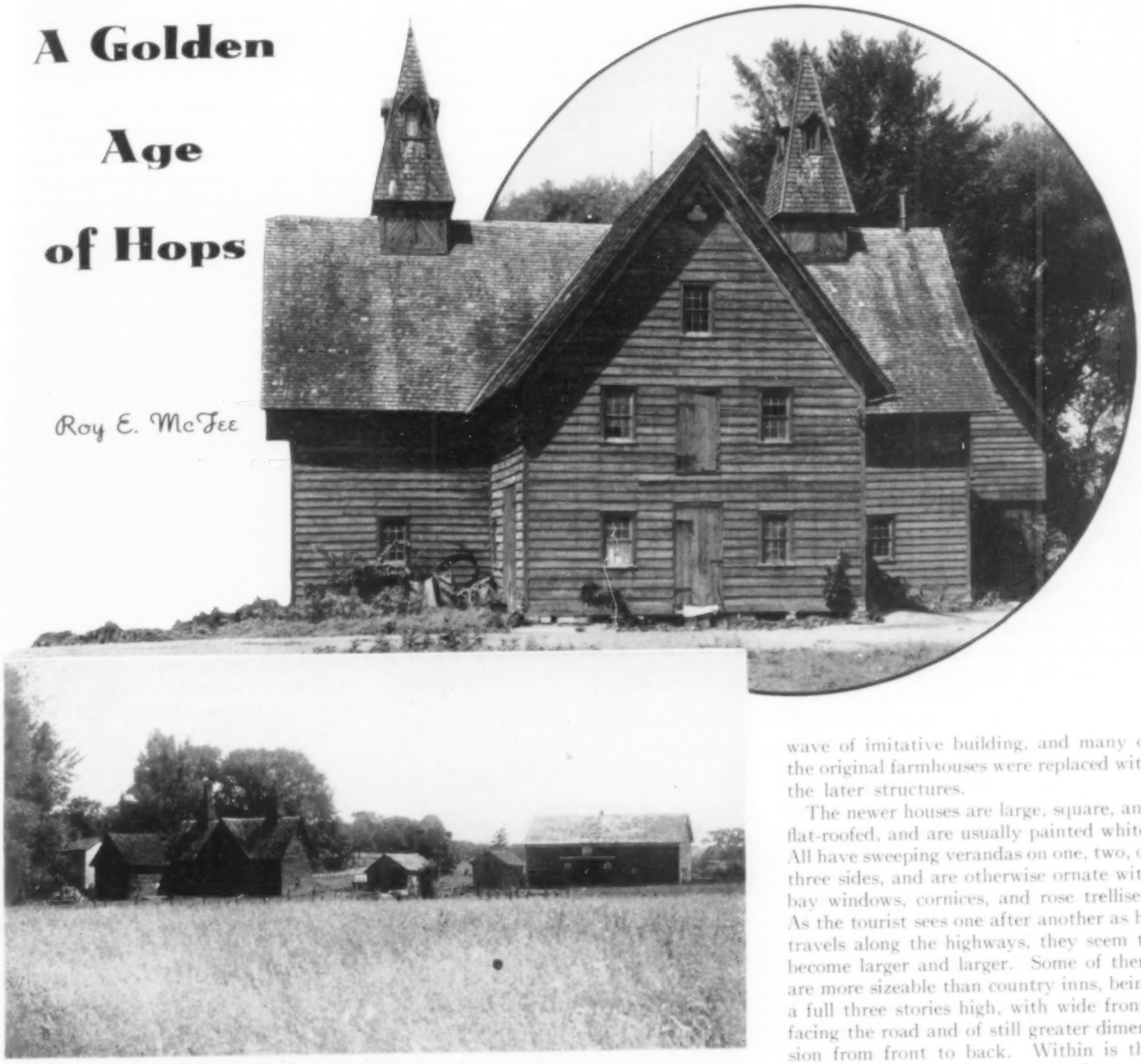
After the concrete is mixed it is dumped into 8-cubic-yard buckets and placed by means of seven radial cableways operated from a single head tower 460 feet high. This tower is located just upstream from the axis of the dam and on the west abutment. The cableways extend to smaller tail towers—five on the east side and two on the west side of the river—that travel on curved runways, thus putting the entire dam site within easy reach for pouring concrete.

A total of 6,000,000 cubic yards of concrete will be required for Shasta Dam, and on July 8, at exactly 10:02 a.m. when the first bucketful was carried over the system, the actual work of building that great structure was initiated. When ready for service, the dam will impound the waters of the Sacramento, Pit, and McCloud rivers for a distance of 35 miles, creating a reservoir with a capacity of 4,500,000 acre-feet. The project is expected to be completed in 1943, and is part of a program to supply water for irrigation, flood control, and power to the central valley of California.

The conveyor belt was designed and constructed and is being operated by the Columbia Construction Company, Inc., with S. J. Davis acting as superintendent and George Scheer as consulting electrical engineer. Walker R. Young is supervising engineer of the Central Valley Project for the U. S. Bureau of Reclamation.

A Golden Age of Hops

Roy E. McFee



WELL-PRESERVED HOP HOUSE

These pictures were taken on the farm of Wiles Buel, near Canajoharie, N.Y. One of them shows the farm buildings from a distance and the other is a close view of the hop house. This is evidently a double structure, with two cupolas.

SOUTH of the Mohawk River in the State of New York is an agricultural region which has been settled for more than 200 years. Beginning at the Catskill Mountains on the east, the area extends westward to the Finger Lakes and constitutes perhaps the most prosperous farming country of the Empire State. There is an air of stability and security about the district that seems to date from the time it was founded by the first colonists, which included thrifty Dutch from the Hudson River, Scotch and English from New England, to be followed soon after by Palatines fresh from their beloved orchards and vineyards along the Rhine. The present inhabitants not only are the descendants of those sturdy pioneers but actually live among the landmarks of those earlier days.

Many of the attractive farmhouses are already far along in their second century of life. Their architecture is clearly of the colonial period. Much of it is Dutch—long and low of design, with the doorway, of simple dignity, in the middle of the front. Within some of them may still be seen ceilings of timbers and boards, all painted and clean as during the lifetime of their first owners. But the casual eye will be attracted to another type of house, especially in the eastern part of the region. It will be found on farm after farm, and everywhere in sharp contrast to the older dwellings of the venerable countryside. All are around 50 years old. Evidently, in the late nineteenth century there was a wave of imitative building, and many of the original farmhouses were replaced with the later structures.

The newer houses are large, square, and flat-roofed, and are usually painted white. All have sweeping verandas on one, two, or three sides, and are otherwise ornate with bay windows, cornices, and rose trellises. As the tourist sees one after another as he travels along the highways, they seem to become larger and larger. Some of them are more sizeable than country inns, being a full three stories high, with wide fronts facing the road and of still greater dimension from front to back. Within is the same spaciousness. There are often two parlors, besides a music room and a stately hallway with a staircase leading up to as many as six or eight big bedrooms high of ceiling and light.

Today many of these mansionlike homes are only partly used by the occupants. However, the original owners had them furnished from wall to wall, the rooms, in some cases, being in different colors like those in the famous White House in Washington. To build and furnish such houses would cost enormously now, and even then the expense involved must have been great. The whole situation bespeaks of an era when money was plentiful in this particular section.

The solution to the mystery is found among the other farm buildings. In addition to the ordinary barns, chicken houses, pig pens, tool sheds, and corn cribs, there is a well-built structure with a cupola. Inspection shows that the front half of the building has a lower floor of smooth, tight construction, and that a stairway reaches to an upper floor that also is tight and has walls finished to a considerable height. The rear consists of a huge compartment, undivided from the earth floor to the shingle roof but connected by doorways or other openings with both floors of the front half. This great space is now invariably used for hay storage, but there are ample evidences that it served a different purpose in the days gone. Here and there, lath and plaster still cling to the studding, while midway between basement and roof are marks indicating that a floor has been torn out. On the ground are stone foundations for a furnace. Altogether, the structure has the appearance of a warehouse. And lastly, although it may have been used as a tool house and hay barn for 30 years or so, it is always called "the hop house."

Half a century ago, hop growing flourished in the region, and the hop houses and the expansive homes are the landmarks of that era when gold was to be picked up from the furrows, figuratively speaking. The hop houses were a necessary feature of the industry; and the farm mansions were the expression of the resulting wealth. But why should hops have been of such importance in the agricultural scheme of southern New York? The answer lies in economic history. The plant has been commercially valuable for some 1,000 years because of its chemical content, including hop oil, resins, tannin, wax, and bitters. Undoubtedly hops are best known for their use in the brewing industry, and by reason of this and other fields of application the market demand has been continuous.

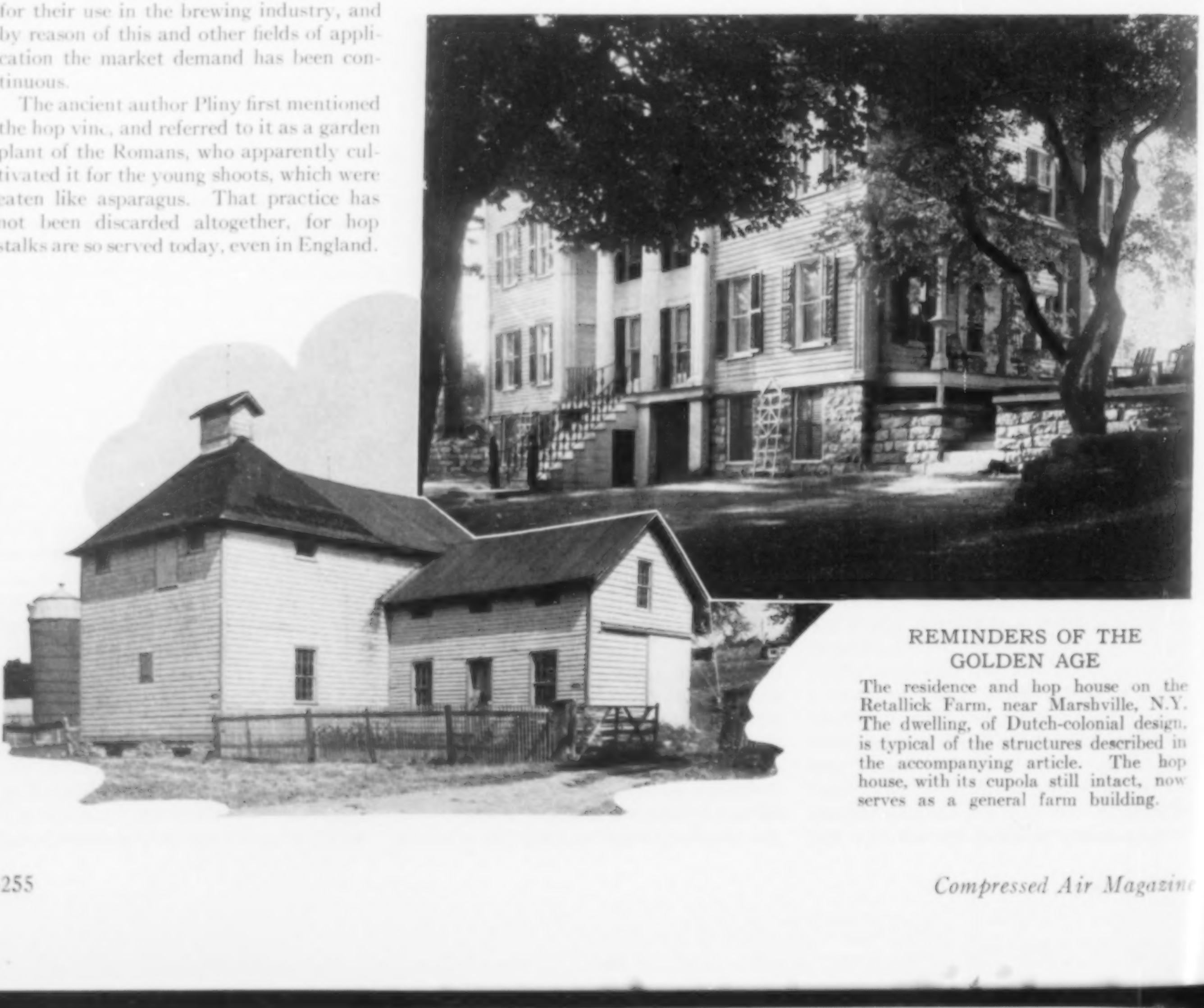
The ancient author Pliny first mentioned the hop vine, and referred to it as a garden plant of the Romans, who apparently cultivated it for the young shoots, which were eaten like asparagus. That practice has not been discarded altogether, for hop stalks are so served today, even in England. Incidentally, the mere thought of eating them is disconcerting to the average person who has had any experience with the forbidding exterior of the mature vine.

Hops are native of both Europe and Asia, and have been grown on a large scale in England, Germany, France, Australia, and New Zealand. They were introduced into England as early as the eighth century, and American hop culture began in New Netherlands in 1625. By the first half of the nineteenth century the chief hop-raising states were Vermont, Massachusetts, and Maine, with Vermont alone producing seven-eighths of the entire United States crop. Subsequently, when it was found that hops grown in New York were superior in quality, the New York yield jumped to three times that of the New England States, which finally abandoned the industry, leaving New York without competition.

Hop culture has always been limited as to locality, because the plant requires a comparatively mild climate, with an abundant rainfall in the early months but scanty precipitation as the crop matures. The hilly country of southern New York proved to be especially well suited for the purpose, and it was not long before the region south of the Mohawk and of the old Erie Canal, extending in longitude roughly from Albany to Rochester, became the hop yard of the country. Indeed, between 1850 and 1865, that section had a monopoly on the business in the United States. After a temporary depression, hop roduction there was at its height from 70 until 1890. Those forty years were he golden age of hops in the State of ew York.

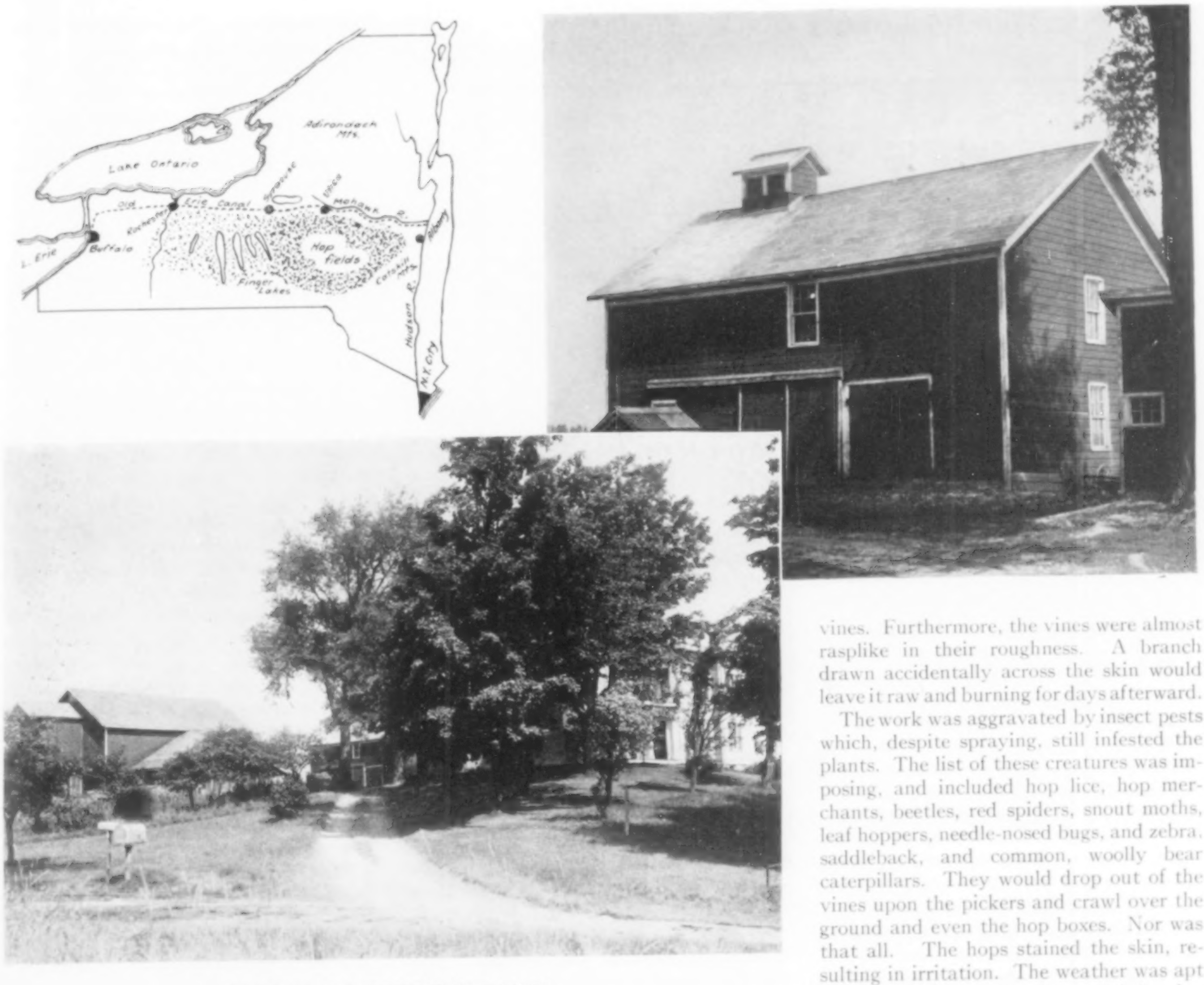
Despite the fact that the young p vine is tender enough to be eaten, it is ecidedly rugged, and while a mild climate is needed for a good crop, the plant itself can resist severe weather. Indeed, hops have survived in the very shadow of the Citadel of Quebec, Canada. Hops are perennial, growing stalks from 15 to 30 feet in length each year. They are twining and exceedingly coarse, with abundant large, rough leaves. The hop of commerce is the female flower of the vine that is shaped like a cone and composed of numerous large scales.

When New York began the intensive cultivation of hops, the locations for the yards were selected with care. The general requirement was rich alluvial land, or deep sandy loam. Further, it was necessary that the fields be easily tilled, protected, and well drained. New yards were usually started from root cuttings, with two or more transplantings before the vines came into good fruition. They were finally planted in hills about 7 feet apart in both directions, and high overhead, on poles, was strung an elaborate trellis of wires and twine. The ground was tilled by a cultivator, pulled lengthwise and crosswise of the field by a horse, and by hoeing endlessly. Then the vines had to be trained to climb up the poles and along the wires and



REMINDERS OF THE GOLDEN AGE

The residence and hop house on the Retallick Farm, near Marshville, N.Y. The dwelling, of Dutch-colonial design, is typical of the structures described in the accompanying article. The hop house, with its cupola still intact, now serves as a general farm building.



BENJAMIN KOUGHER FARM

The spacious, well-kept house is nearly hidden by the trees that have matured since it was built. The hop house, converted into a general service building, has been well maintained through the years. The map shows the area of New York State in which hop growing formerly flourished.

strings. For this purpose was used a horse-drawn cart with a high platform, the workers spending hours standing on it and reaching up into the top of the trellis. All this cultivation and tending was interspersed with spraying to control blue mold and insect pests. Although the hop yards represented only a small part of the farm acreage, they received so much attention that when the dinner bell rang the men were found there more often than anywhere else.

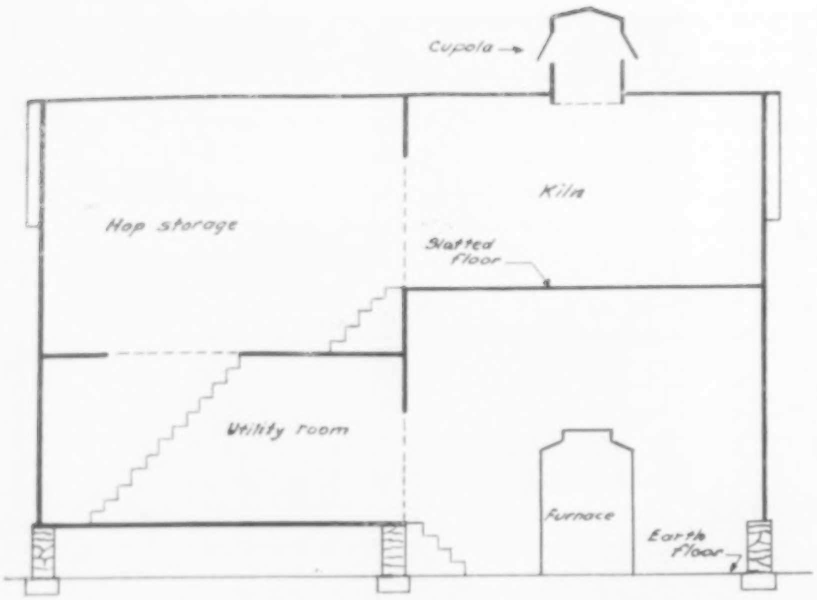
Hop-picking time was the event of the year. It came in early September, and Nature herself set the scene. The hay and grain had long since been harvested, giving a neat and trimmed appearance to broad reaches of the countryside. Against this background, varied somewhat by orchards and standing corn, the hop yards stood out in bold relief. At that season they were literally vast overhead networks of vines and foliage, suspended in endless chains from pole to pole and from wire to wire and shading most of the ground underneath. The flowers were of full size and nearly as firm as a pea pod.

The actual picking was done by hand. Huge boxes, divided into four compartments of 10 bushels capacity, were carried into the field by means of board handles at the corners. The vines were then cut off above the ground and delivered by tenders to the boxes, where the hops were removed by pickers standing each at his own compartment and usually protected from the sun by awnings. Gloves were worn by both pickers and tenders. Payment for picking was based on the number of boxes filled, while the tenders worked by the day.

The difficulties of hop picking were very real, and, once experienced, were certain to be remembered. In the first place, the work was hard, and the days long—from seven o'clock in the morning until six at night, which meant at least ten hours of picking hops, pulling poles, or slashing vines. Furthermore, the vines were almost rasplike in their roughness. A branch drawn accidentally across the skin would leave it raw and burning for days afterward.

The work was aggravated by insect pests which, despite spraying, still infested the plants. The list of these creatures was imposing, and included hop lice, hop merchants, beetles, red spiders, snout moths, leaf hoppers, needle-nosed bugs, and zebra, saddleback, and common, woolly bear caterpillars. They would drop out of the vines upon the pickers and crawl over the ground and even the hop boxes. Nor was that all. The hops stained the skin, resulting in irritation. The weather was apt to be chilly in the morning and blistering hot by noon, with perhaps a drizzling rain by evening. Finally, because of the heat and the jarring or moving of the boxes, the job of filling them seemed endless because the hops already gathered had a tendency to keep on settling. As a consequence, after a couple of weeks of picking, young boys especially were apt to feel very kindly disposed towards such minor nuisances as thistles, blackberry briars, and poison ivy.

The hops were dried during the night immediately following picking, and it was for this purpose that the hop houses were built. A fire was kept in the furnace, and the crop was placed high above it on a burlap-covered slatted floor. When thus properly cured, the hops could be safely stored on the second floor in the front end of the building. Incidentally, drying reduced the weight by nearly 60 per cent. In the process, sulphur fumes were used to color the hops slightly for the sake of appearance. Naturally, this part of the work was of extreme importance, and the proprietor usually attended to it himself. He delegated the supervision of the picking to his son, while he slept by day and kept watch over his precious kiln of hops by night.



LONGITUDINAL SECTION THROUGH A HOP HOUSE

In the early days of the industry, hop picking was an occasion which called upon the entire labor resources of the community. The able-bodied men did the heavier work, such as pulling the poles and handling the vines, boxes, and sacks. But the yards also had plenty to do for the older men, the women, and the children. Often the opening of school was delayed. Indeed, the neighborhood schoolmaster probably was the owner of a small farm with a hop yard. However, when hop growing was at its peak in New York State, local labor was not sufficient. Then the nearby industrial communities were drawn upon, and agents recruited parties numbering from 20 to 40 for each farm. These were often factory workers temporarily out of employment; but sometimes they were persons desirous of combining an outing in the country with a chance to earn some money. Usually those in one group were acquaintances, or at least were from the same locality. So they came as on a picnic. They were met at the railroad station and transported with horses and wagons to the farms; and for days, both coming and going, they made the staid hills resound with songs and cheers.

At each farm, preparations to receive them had been made long in advance, and standard equipment was kept on hand for their accommodation. The clean first floor in the front half of the hop house was temporarily partitioned with curtains of heavy burlap; and the sleeping quarters so formed were furnished with cots and bedding. Occasional couples generally occupied the spare bedrooms in the homestead. In the kitchen, the table was extended the full length of the spacious room. Flour and crackers were bought by the barrel; and the housewife with all available help settled down to perhaps two weeks of peeling potatoes, cooking, and washing dishes for a festival crowd.

In the hop fields the recruits were not very efficient. For one thing, experience was necessary to become a fast picker, and many of the willing hands were therefore handicapped. Then, too, many others came mostly for recreation and the assurance of three good farm meals a day. Moreover, the intensive and crude social life inaugurated by them immediately upon their arrival was a serious distraction.

Naturally, the influx of hundreds of city folk in organized parties disrupted the normal life of the community. Their numbers were so overwhelming, comparatively, that for the period of their stay the community simply made way for them. After the day's work was done and a satisfying supper had been eaten, night life held sway. The country roads were filled with the strangers as they went for visits from farm to farm. There was a continuous series of barn dances. First one and then another of the farms would entertain. Kerosene lanterns furnished the light, and an improvised orchestra of a violin or two provided the music. The atmosphere, which was naturally influenced by the social plane of the participants, was invariably rough. But the early hours found everyone at home and asleep again, at least in time to be resentful of the morning breakfast bell.

The happiest reflection of the hop growers was that they paid only for work performed, and that the free meals to loafers were the only loss. Finally, with relief, the community saw the crop under cover, the pickers take their leave, and peace and order return. More leisurely, then, the discarded vines were burned in the fields and the valuable hops rehandled in the storeroom on the upper floor. Study and discussion followed as to the market price; and at length, in the winter, the crop was sold to a buyer. The press was set up and burlap baling bought. The hops were compacted, sewed into bales, and hauled to the railroad station. The arrival of the check completed the year's toil.

It is evident that hop raising was a gamble, even in this favored region of New York and in the days of its monopoly. Perhaps that was one of its attractions. Considerable capital was required. There was the investment in the hop house and its special equipment, in the field tools, and in poles and wire. There were heavy maintenance costs, and the continual outlay for twine, burlap, and other supplies. Added to all those expenditures were the costs for the year's labor, both cultivating and picking.

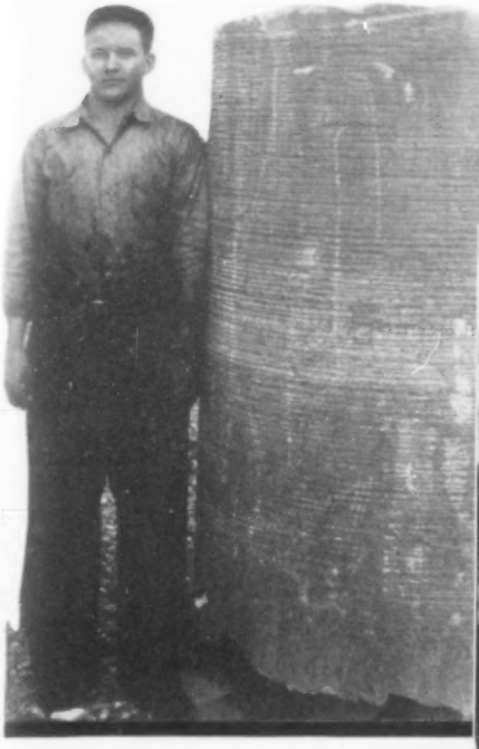
Despite the investment and planning there was always the chance of a complete crop failure. In fact, on an average, one failure occurred every seven or eight years. There were other years during which the yield barely paid back the actual outlay in money. At such times, the family had to be content with the income from the secondary, rather neglected crops of the farm. But there were seasons when fortune smiled, and sometimes these would come in succession. The crops would be bountiful and, because of economic conditions, the price would soar. Once it reached a dollar a pound, and became historic. After such a year the grower paid off the mortgage in one big lump sum. After two more he built a new house, square and flat-roofed like those of his neighbors, but a little larger than any previous one. If his good fortune continued, he invested in more farm land, or speculated in wheat on the Exchange.

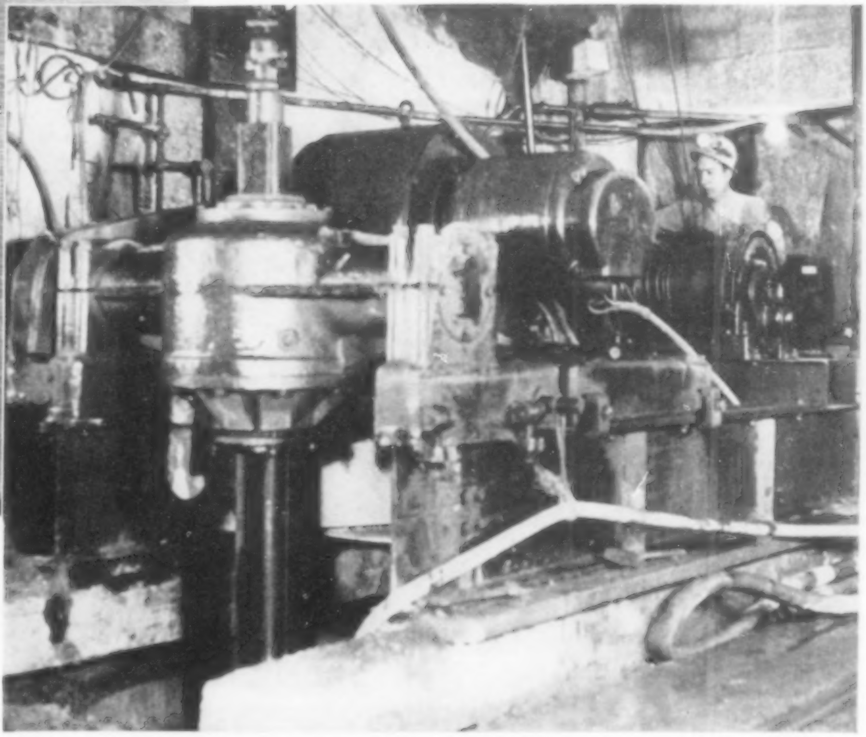
Of course, the age of riches could not last; but it did hold on tenaciously. In 1860, and again in 1866, the hop crop in New York was completely destroyed by insects. Those disasters encouraged Michigan and Wisconsin to start hop yards which, however, did not last long. New York quickly recovered the leadership and kept it until 1890, when competition from another quarter—the Pacific coast—had to be fought. Gradually the well-established eastern hop yards lost in the rivalry. They were still struggling as late as 1910; but today the center of the United States hop industry is in Washington, Oregon, and California.

In the intervening years, New York State has developed a steadier source of farm income. The hop yards have been turned into meadows and cornfields and the hop houses into storage places for clover, timothy, and harvesting machinery. Silos have been built. The dairy products of Holstein and Guernsey cattle bring in a steady revenue. Quiet has returned to the erstwhile hop country. Lazy herds now roam the fields that once were colorful with men, women, and children under the green festoons of the hop vine. Owners are the solitary visitors to the lonely hop houses where, in their heyday, strange throngs from the city made merry through the night. And in the great square dwellings, newer generations listen to tales of fortunes made in hops.

Calyx Core Drilling at United Verde Mine

C. E. Mills[*]





DRILL AND CORE

These pictures show the Calyx core drill, set up for boring a ventilation hole, and a section of 48-inch core extracted by it. The core illustrates the cleanness with which the rock is cut and the freedom from shattering that necessarily accompanies ordinary drilling and blasting operations.

CALYX drilling has been used in the underground operations in the United Verde Mine as a substitute for the usual raising and winzing methods, and for driving ore chutes and waste and ventilation raises. It has also been used in boring pilot holes for winzes or shafts where level connections exist at the bottoms of such proposed shafts. This work has been done by means of a WU-48 Calyx drill, which consists essentially of a gear-driven spindle rotated by a 40-hp. motor through a gear-reduction unit, and of air hoists for handling rods and for core pulling. The equipment is mounted on a structural-steel X-type box frame of which the outside members are two 18-inch I-beams 11½ feet long.

The bit or cutting tool furnished with the drill is a cylindrical shell, 1⅜ inches thick and 48 inches in outside diameter, with slots in the edge of the cutting shoe to feed shot into the groove drilled by the bit. The top of the bit is sealed by a plate that carries a hub for attaching the drill rods; and an inner plate, slightly less in diameter than the shell, distributes the shot and water directly over the groove instead of over the center of the core. The bit is 7 feet long over-all; and the lower half is renewed whenever the bit is worn to such an extent that the length of the core is limited to less than 4 feet. A new type of bit, designed at the United Verde Mine, is made up of an inner and an outer shell of ½-inch plate with a spacer of ⅜-inch plate that is slotted vertically over the angle slots in the cutting edge. This bit is fashioned of Corten steel and is of advantage in that it delivers the

PHELPS Dodge Corporation is the second largest producer of domestic copper. In 1939 the company reported an output of approximately 300,000,000 pounds of the metal. It is known to have large ore reserves capable of sustaining production for many years to come.

The company's principal mining properties are in Arizona, and include the Copper Queen Mine at Bisbee, the Cornelia Mine at Ajo, the Morenci Mine at Morenci, and the United Verde Mine at Jerome. A small yield is obtained from the Pilares Mine in Sonora, Mexico. Although mining is primarily done for copper, considerable quantities of gold, silver, lead, selenium, and tellurium are recovered as by-products. The company also owns coal mines at Dawson, N. Mex., and operates power plants to meet its own requirements at the various branches.

Phelps Dodge has three copper smelters in Arizona and owns two copper refineries, one at El Paso, Tex., and one at Laurel Hill, N. Y. Approximately 55 per cent of the copper produced is fabricated in the corporation's own plants, this work being carried on by a subsidiary, the Phelps Dodge Copper Products Corporation, at Bayway, N. J., Fort Wayne, Ind., Yonkers, N. Y., and Los Angeles, Calif. Fabricated products comprise a complete line of copper, brass, and alloy rods; bare and insulated wires and cables; copper, brass, and alloy pipes and tubing, strips, etc.

Phelps Dodge was one of the first mining companies to adopt large-diameter core drills for selected work in underground operations. The accompanying article summarizes its core-drilling experience in the United Verde Mine.

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[*] Chief Engineer, Phelps Dodge Corporation, United Verde Branch.

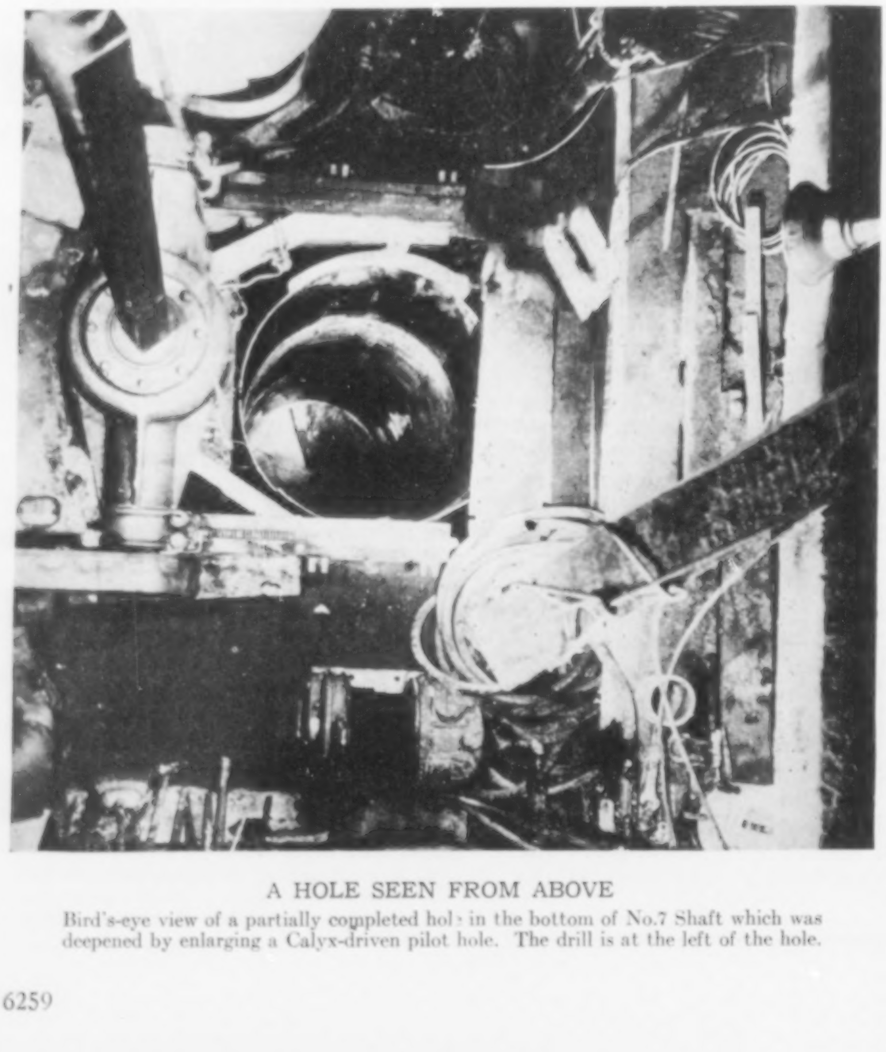
GENERAL VIEW OF MINE SHOPS

The long structure in the foreground is the change room, and left of it is the boiler house. The rectangular building in the left-center is the compressor house. The other buildings are machine shops, warehouses, etc.

chilled shot to the bottom of the slots.

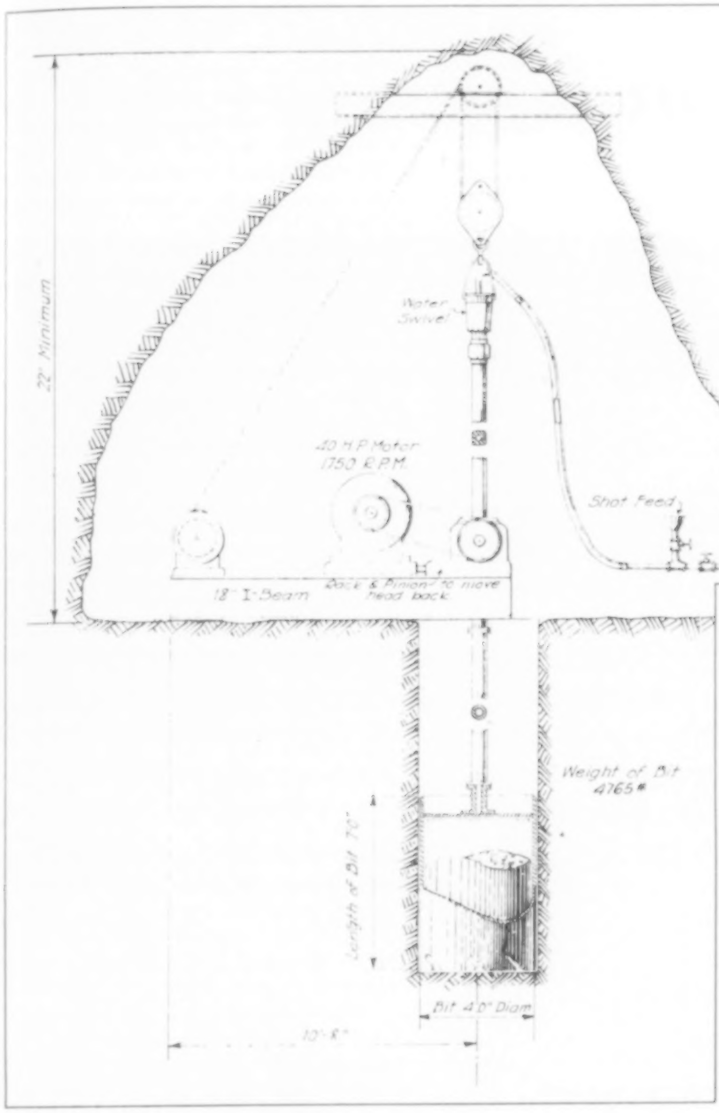
The core puller consists of a ⅜-inch cylindrical, steel shell with a tapered ring plate at the bottom and is lowered over the core after the explosive has been placed in the bottom of the groove. The core is held by several steel wedges which are attached to the ends of ⅝-inch rods and driven between the core and the tapered ring plate.

The total weight of the equipment, including rods, is 14 tons. With a 10-foot spindle, water swivel, and head sheaves, the drill has to have about 22 feet of headroom. This, although it need not be more than 4x6-feet in cross section at the top, is required to permit handling the core and tools. The drill station itself is approximately 8x16-feet in size, as one of the illustrations shows. The hole is begun with a starter bit 30 inches in length and of the same diameter and shell thickness as the 7-foot-long bit. The collar of the hole is usually protected by a ¼-inch plate ring to prevent loose rocks from falling into the opening. In hard ground, added pressure is applied to the cutting edge by means of a small air hoist rigged with its cable in a position to give a downward pull on the rods. As the hole deepens, the weight of the



A HOLE SEEN FROM ABOVE

Bird's-eye view of a partially completed hole in the bottom of No.7 Shaft which was deepened by enlarging a Calyx-driven pilot hole. The drill is at the left of the hole.



rods, or the pressure exerted by them, is sufficient for drilling; and in soft rock the weight may be lessened by means of the service hoist. To eliminate whip in the drill rods, centralizers are placed on every third rod.

Chilled shot, of 10 to 12 gauge, is fed through the drive spindle and rods along with the feed water at intervals of fifteen to twenty minutes, depending on the rate of cutting. Sludge is handled by two Size 25 air-driven sump pumps connected in series and discharging into a temporary dam to permit solids to settle before the excess water enters the mine drainage system. At a depth of 150 feet or more, the sludge is removed by a bailing bucket raised to a point near the collar of the hole and emptied by one of the sump pumps.

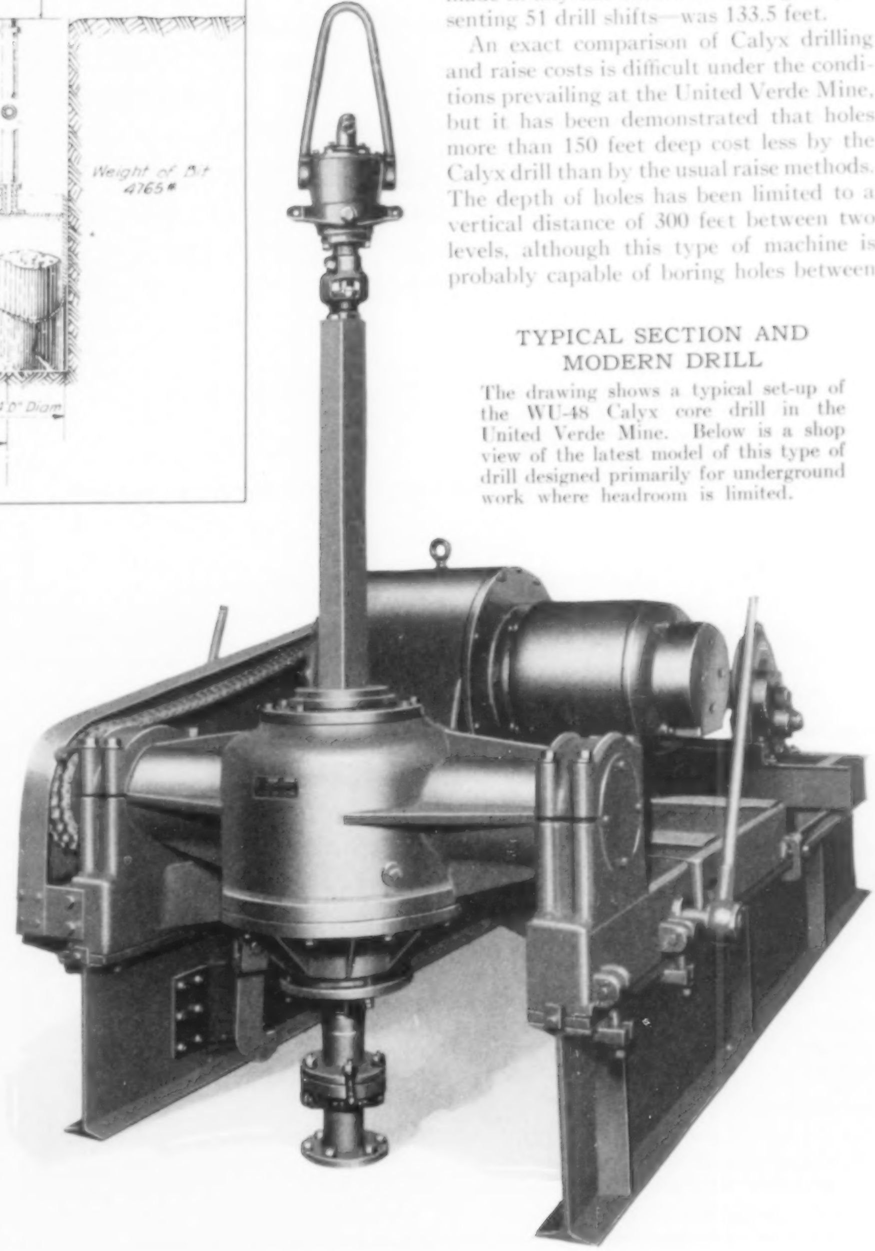
In pulling a core after drilling, the hole is pumped or bailed, and one-third to three-quarters of a stick of 1⅛-inch 50 per cent gelatin dynamite, with an electric detonator, is attached to the end of a wooden slat and placed in the bottom of the groove. The core puller is then lowered over the core, the steel wedges are placed, and the shot is fired. The 4 or 5 feet of water in the slot acts effectively as tamping, and very little trouble is experienced in cracking off the core at the bottom. Workmen are lowered in and out of the hole on a bosun's chair or bucket, a small cage having proved unsatisfactory. The crew consists of three men, one acting as a leader. In hard ground, where the drilling cycle is one full shift or more, the crew is limited to two men during the actual drilling period.

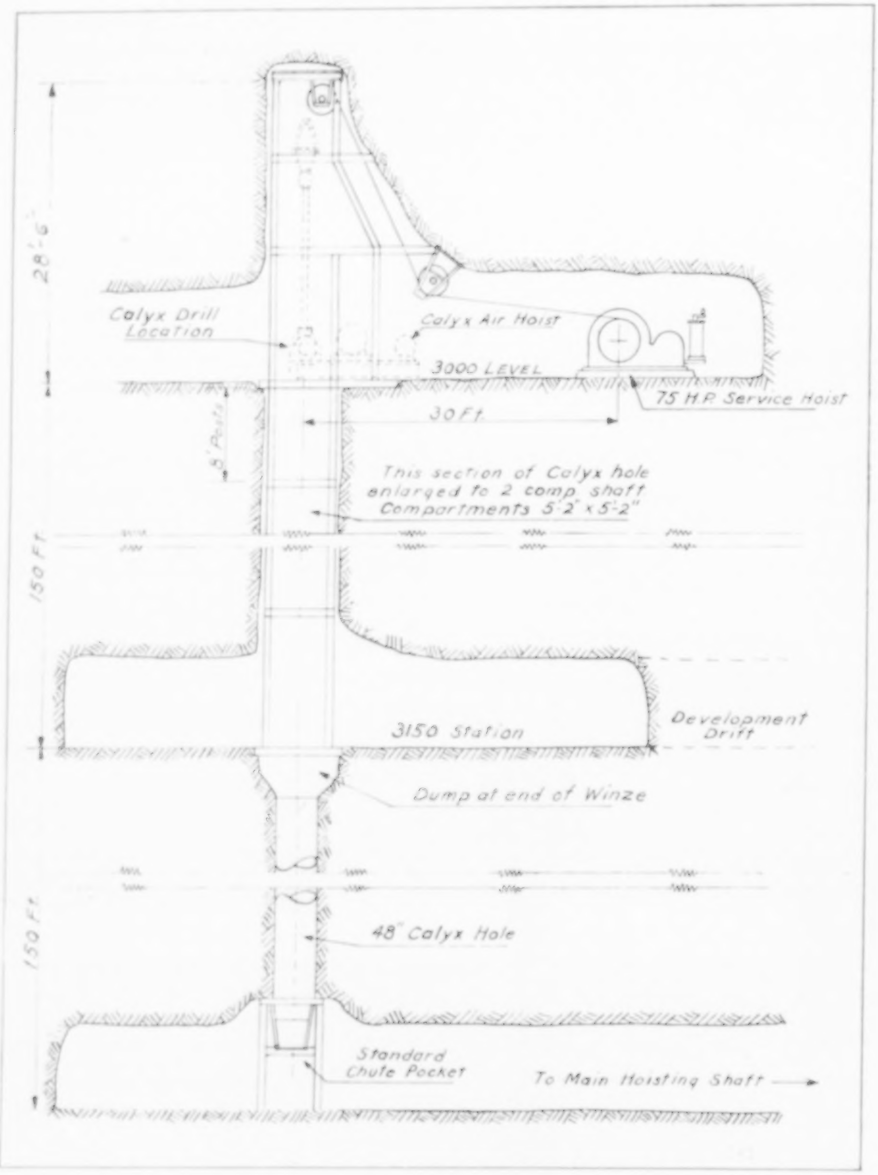
Progress in Calyx drilling, or footage per operating shift, depends largely on the hardness and character of the ground, the amount of cementing necessary, the quantity of water in the ground, and on the depth of the hole. If the ground is badly fractured and cannot be pulled, hand mucking naturally retards progress materially. The best footage made in any two consecutive shifts in porphyry was 11 feet 3 inches at a depth of 42 feet. At a 200-foot depth, the best 3-shift run was 10 feet. The best footage made in any one month of drilling—representing 51 drill shifts—was 133.5 feet.

An exact comparison of Calyx drilling and raise costs is difficult under the conditions prevailing at the United Verde Mine, but it has been demonstrated that holes more than 150 feet deep cost less by the Calyx drill than by the usual raise methods. The depth of holes has been limited to a vertical distance of 300 feet between two levels, although this type of machine is probably capable of boring holes between

TYPICAL SECTION AND
MODERN DRILL

The drawing shows a typical set-up of the WU-48 Calyx core drill in the United Verde Mine. Below is a shop view of the latest model of this type of drill designed primarily for underground work where headroom is limited.





DEVELOPMENT PLAN FOR WINZE

This hole was drilled last November from the 3000- to the 3300-foot level. The upper 150 feet was enlarged into a 2-compartment shaft by underhand mining. The lower 150 feet was utilized as a standard chute pocket for the disposal of development muck. The 75-hp. auxiliary hoist indicated at the top-right was used in connection with the enlarging of the shaft and the driving of a development drift on the 3150-foot level.

400 and 500 feet deep. The use of Calyx holes at this mine has been confined to: 1—Fill holes for stopes where ore outlines are definitely known and where the holes are vertical; 2—ventilation raises where the volume of air required does not exceed 60,000 cubic feet; 3—exploratory shafts or preliminary holes for a shaft to facilitate enlarging it to full size.

The Calyx drill is not intended to nor will it ever replace the usual procedure of driving raises with stopers. Although the head of the machine is pivoted to permit boring inclined holes, it is obvious that it is not suitable for following irregular ore areas. The expense of cutting stations and of moving and setting up the drill limits its use in average mining operations. The method is particularly adapted for drilling ventilation raises or for deep-hole shaft work.

The advantage of Calyx drilling over raising is that it is essentially a safer and easier operation. The hazard of physical injury to miners is much less; and dust, encountered in raise mining, is eliminated. Under certain conditions it permits drilling stope fill holes without stopping mining activities, as is necessary in driving raises.

The 48-inch Calyx drill was placed in operation in October, 1937, and up to November, 1939, had bored eight holes with an aggregate footage of 1,256. No attempt has been made to keep the drill in continual use: it has been limited to work for which it is suited. Five of the holes were drilled to serve as fill raises for stopes. These varied from 56.5 feet to 115 feet in depth, and had a total footage of 456. The remaining three were drilled from the 3000- to the 3300-foot level: one to serve as a main ventilation raise for lower-level development and two as pilot raises in shaft sinking. The last hole, which was completed in November, 1939, was drilled from the 3000- to the 3300-foot level for development work on the 3150-foot level. The upper 150 feet was enlarged for 2-compartment shaft timbers by underhand mining, while the lower 150 feet was used as a chute for mucking, as one of the accompanying drawings shows. No trouble was experienced in breaking the ground or passing the muck through the 48-inch hole from slabs or hang-ups in the hole. The latter was in comparatively hard porphyry and was drilled at an average speed of 7.8 inches per hour. The cost per foot averaged $12.46.

General Drilling Data and Costs

	AVERAGE GROUND	HARD SIL. SUL.*	AVERAGE 8 HOLES
Depth of holes, feet	281.50 Max.	56.50 Min.	157.00
Footage per drill shift	2.76	0.79	1.94
Drilling speed, inches per hour	14.10	1.57	7.75
Drilling time, per cent of total	20.40	72.20	45.30
Pounds shot per foot of hole	22.80	103.50	38.20
Bit wear, inches per 100 feet of hole	6.60	42.90	14.90
Operating Costs Per Foot of Hole**			
Labor	$6.62	$19.00	$10.06
Calyx shot	2.92	7.16	2.86
Supplies	0.13	1.07	0.51
Timber and explosives	0.18	0.05	0.11
Electric power	0.25	0.89	0.45
Total	$10.10	$28.17	$13.99
Approximate cost of cutting full-sized stations			$345.00
Average cost of moving and setting up drill			$237.00

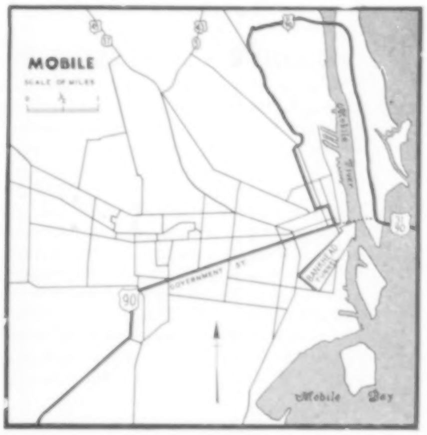
*Hard siliceous sulphide
**Operating costs include labor, timber, explosives, chilled shot, supplies, power, and core disposal

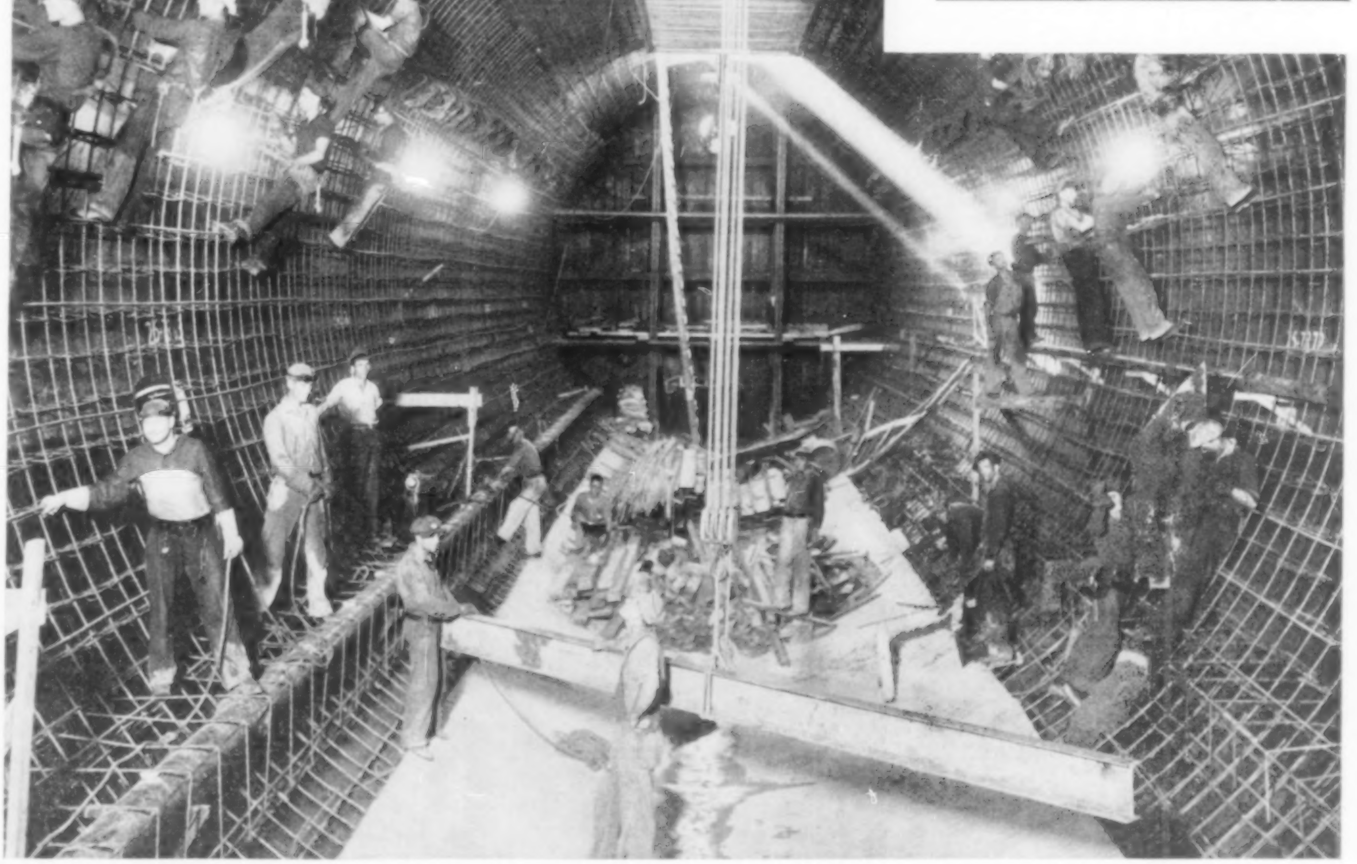
Typical Labor Distribution for Hole in Average Ground

OPERATION	PER CENT
Drilling	39.1
Pulling rods	10.9
Pulling core	10.1
Mucking core	14.6
Pump or bail	6.9
Repairs	0.4
Miscellaneous	4.8
Delays	0.6
On and off shift, lunch hour	12.6
Total	100.0

Mobile Builds an Under-River Highway

R. G. Skennett





LINING THE INTERIOR

Human spiders move over the web of reinforcing bars, binding them together preparatory to pouring the concrete lining. The invert is already in place, and one of the transverse steel beams that carry the roadway is being swung into position. This work was done while the tube section was floating in a slip at Blakely Island. One of the bulkheads by which the section was made watertight is visible at the far end. The map shows the location of the tunnel and indicates the saving in travel it will make possible. The main highway eastward from Mobile, Route 90, runs northward from the city, crosses the Mobile River by bridge to Blakely Island, and then turns southward. The tunnel will eliminate this 7½-mile detour.

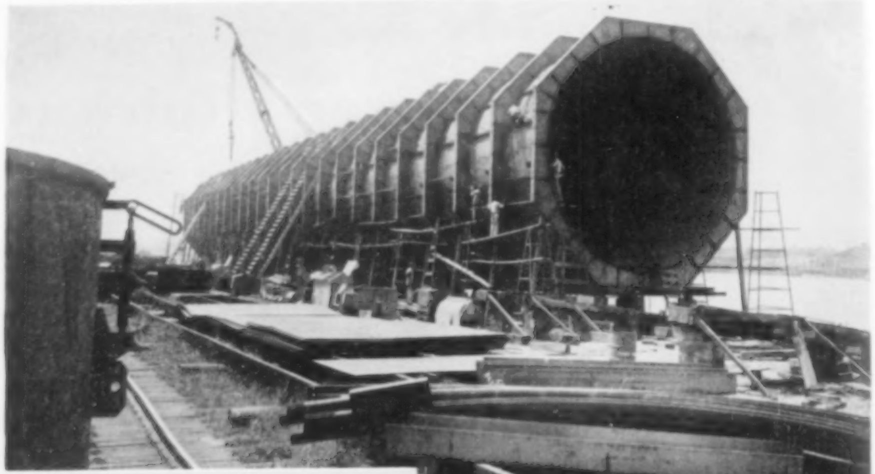
MOBILE, Ala., has just finished a subaqueous vehicular tunnel at a cost of about $4,000,000, and in this engineering work she is setting the pace for the Deep South. This evidence of marked up-to-dateness is all the more of a contrast when it is recalled that Mobile was founded by the French under de Bienville in 1702 on the Old Spanish Trail which the *conquistadors* blazed long before as their pioneer path from the east coast of Florida to the shores of the Pacific. Mobile even now is a fascinating composite of Spanish, French, English, and American influences; and it bears, among others, the nickname of the "City of Five Flags." The fifth flag was that of the Confederacy; and the naval battle of Mobile Bay was one of the high points of the Civil War.

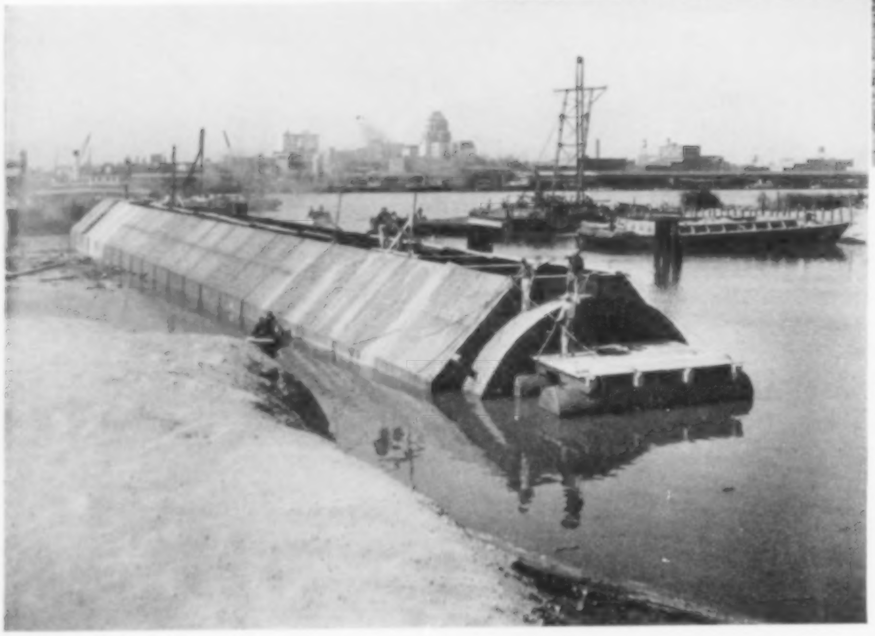
A community of 78,000 people, Mobile is on the west bank and at the mouth of the Mobile River. It is adjacent to the headwaters of Mobile Bay and a focal point for six much-traveled highways. All the traffic heretofore bound to or from the region to the eastward has entered and left Mobile over a looping 7½-mile detour that crosses the Mobile River upon a lift bridge approximately 3 miles north of the city's center. About half of this elongated inverted "U" is on Blakely Island, directly opposite Mobile, and connects with the $2,500,000 Cochrane Bridge and causeway, 10½ miles long, that lands successively on a number of fingerlike islands in spanning the widest water gap along the route of the Old Spanish Trail from Florida to California.

The recently constructed Bankhead Tunnel links Government Street in Mobile

BUILDING A TUBE SECTION

The under-river part of the tunnel consists of 2,000 feet of double tube made up of seven sections which were preconstructed, floated into position, sunk into a dredged trench in the river bed, and joined. The view at the right shows the partly completed steelwork of one of the sections. The plating of the outer octagonal shell remains to be put on before it is launched. Below is a section, with its ends bulkheaded, partly submerged at the Blakely Island slip where the concrete lining was placed and other structural features were added before it was towed into position for sinking.





with U.S. Route 90, towards Pensacola, Fla., near the south end of Blakely Island, where a connection is also made with the western end of the Cochrane crossing. The tunnel obviates the use of several narrow streets in the city in following the very heavily traveled Route 90 and does away with the detour via the lift bridge when bound to or from the east. Some persons urged the building of a bridge; but a bridge at a suitable location and of sufficient height to give clearance to shipping would have required long approaches and the demolition of much valuable property which would have made its cost disproportionately high. As it is, the tunnel does not obstruct nor change the course of traffic of any cross street; and the western portal is in the heart of Mobile where it can best serve local and through traffic.

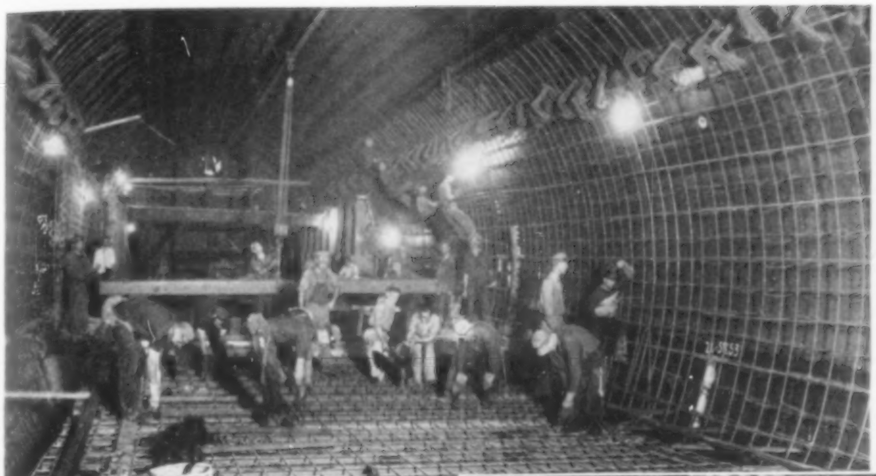
The Bankhead Tunnel is similar in its structural principles to the railroad tunnel beneath the Detroit River between Detroit, Mich., and Windsor, Canada. As will be recalled, that structure is the pioneer of its kind. It is made up of a number of sections which were built on shore, launched, and then sunk in a trench dredged in the bed of the river—the trench being backfilled to cover the units after they were bound together. While the same procedure has been followed in the case of the newer tunnel, still it represents a number of improvements and some interesting departures in engineering practice.

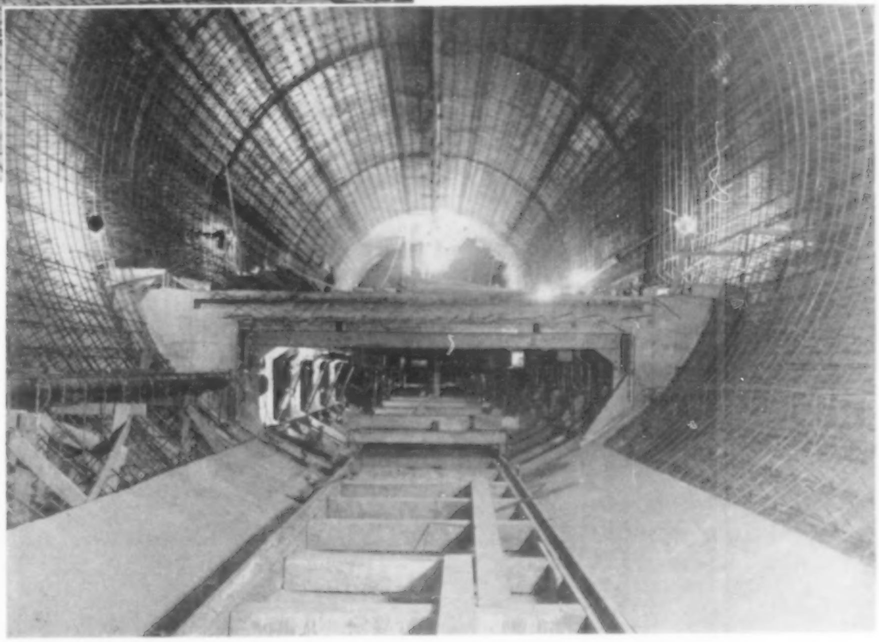
The Bankhead Tunnel is 3,388.5 feet long. Starting at its western, or Mobile, end, it consists of 280 feet of open-cut ramp, a 452-foot rectangular cut-and-cover section of steel-bent construction, 2,000 feet of underwater tube, and a rectangular, steel-bent cut-and-cover section 656.5 feet long. The latter passes through the lower part of the single ventilation building that is provided and that carries the roadway up to ground level on Blakely Island.

The open-cut ramp in Mobile, which begins four blocks from the waterfront, was dug within a steel-sheeted cofferdam to a maximum depth of 75 feet. The soil was coarse sand, and the trench was kept free of inflowing water to a depth of 45 feet by an extensive system of well points. The trench in the river bed was first excavated by suction dredge to a depth of 65 feet and then to the final depth of 81 feet by bucket dredge in order to comply with the requirement of the War Department that the top of the tunnel shall nowhere be less than 45 feet below the low-water level in the main channel. Fortunately, the sandy nature of the bottom lent itself to the trenching operations, afforded a good foundation on which to rest the tube, and made it practicable to backfill the trench quickly and compactly after the tube sections were planted.

The under-river tube was formed by interconnecting seven sections that were built, launched, and placed separately in the trench. Five of these are each 298 feet long, and the two others are each 255 feet in length. They consist of an inner, circular steel tube 30 feet in diameter, and of an enveloping tube octagonal in cross section and having an average diameter of 34 feet—the two being tied together by a succession of steel ribs, with the intervening spaces filled with concrete. The inner tube is lined with reinforced concrete that has a minimum thickness of 18 inches, leaving sufficient space for an elevated police walkway on one side and a 2-lane roadway 21 feet wide between the curbs. The single air duct for ventilating the tunnel underlies the roadway from the ventilation building on Blakely Island to the midlength of the tunnel where there are vents 200 feet east and west of that point through which the vitiated air will be withdrawn at curb level by exhaust fans.

The system of ventilation differs from that heretofore employed in other subaqueous vehicular tunnels. No blowers are used, but an induced flow of air inward at the portals—resulting from the action of the suction fans—is relied upon to maintain the atmosphere within the prescribed safe limits of carbon-monoxide dilution. The





PLACING ROADWAY SLAB

The picture at the left shows the transverse beams and the reinforcing bars laid over them, ready to receive the concrete. Below is seen a section of the roadway slab in place with the collapsible steel form still in position underneath it. The opening beneath the slab is part of the ventilation duct.

system adopted is based upon the findings of the U.S. Bureau of Mines, whose experiments have revealed that hot carbon monoxide reverses its tendency to rise when cooled. Accordingly, the inflowing air from the portals is counted upon to help cool the exhaust gases from automobiles and to stimulate settling toward the vents in the low midlength section of the tube. Only three suction fans, each driven by a 350-hp. motor, have been installed. They are capable of exhausting 274,000 cfm. of air. Normally, only two of the three fans will be operated continuously, the third one being a reserve unit. A carbon-monoxide analyzer will automatically bring the fans into action the instant the tunnel atmosphere has a content of more than 4 parts of the gas in 10,000 parts of air.

The general contract for the tunnel was held by The Arundel Corporation, Baltimore, Md. That concern delegated the dredging of about 1,000,000 cubic yards of mud to the Murnan Dredging Company, and subcontracted with the Alabama Drydocks & Shipbuilding Company of Mobile for the construction of the tubular steel sections. The latter were built in the shipyard and then sent down suitable ways into the river. Before launching, each section was sealed at the ends with temporary steel bulkheads and filled with air at 5 pounds pressure. All external joints were coated with soapy water so that escaping air would promptly blow tell-tale bubbles. The structural work was done so well that but few leaks developed, and those were easily closed.

After a section was launched, it was drydocked in the shipyard, and there, while resting upright on supporting keel blocks, concrete was pumped into the bottom intercostal spaces between the inner and the outer tube. The weight of the concrete increased the stability of the section when refloated and facilitated its handling while being towed to a slip half a mile distant on Blakely Island. At that point the concrete lining of the inner tube and the roadway slab and curbs were poured. The ducts for the lighting circuits, telephone lines, etc., were also installed in the side walls. These ducts are of asbestos-cement, an innovation in service of this kind. Access to the interior of each section was provided by cutting several hatches of ample dimensions in the crown plating of the circular shell. Those openings were sealed after they had served their purpose and shortly before the tube was made ready for sinking at its given position in the river-bottom trench.

Steel forms were used in pouring the 18-inch lining of the inner shell, the concrete being placed in three lifts with ⅝-inch longitudinal and circumferential reinforcing rods. The roadway slab, which is reinforced and rests on transverse 10-inch I-beams, has a thickness of 16 inches, is belt finished, and designed to take the direct wear of traffic, thus avoiding the use of any type of replaceable paving.

As concrete was added to the tube section while in the slip at Blakely Island, the structure settled deeper and deeper into the water, but the final concreting was not done until after it had been towed and moored directly over the river trench. At that stage it retained a reserve of buoyancy of 10 tons. Then the concrete forming the crown section between the inner and the outer shells was pumped into place from a floating plant anchored alongside, giving the unit sufficient dead weight to make it sink when lowered into the trench by the aid of sustaining slings at the two ends. Those slings were pendant from two 24-ton chain hoists secured adjacent to the outer ends of sustaining transverse I-beams of a gallows frame.

Before a tube section was sunk, the dry inner shell was placed under internal air pressure for 24 hours to make certain that it was thoroughly watertight. That test being satisfactory, it was lowered until it was 2 feet above the bottom of the trench and in correctly aligned contact with the previously planted section. Alignment was assured by introducing two steel fingers or pins into corresponding slotted brackets around the edge of the unit to be adjoined. After initial contact was thus made, divers placed "steamboat ratchets"—really a form of turnbuckle—over opposed lugs at six points on the facing ends of the two sections and then worked them until the ends were drawn snugly together. One end of one of the tubes was provided with a projecting collar of steel plating, and this fitted into a circular recess on the other section which carried a heavy rubber and rubberized-cord gasket, thus effecting a watertight seal. Later, each one of these joints was enveloped by a collar of tremie-poured concrete which embedded the linking ratchets, the encircling forms required for this purpose being made up of steel plates dropped into recesses at the ends of the sections.

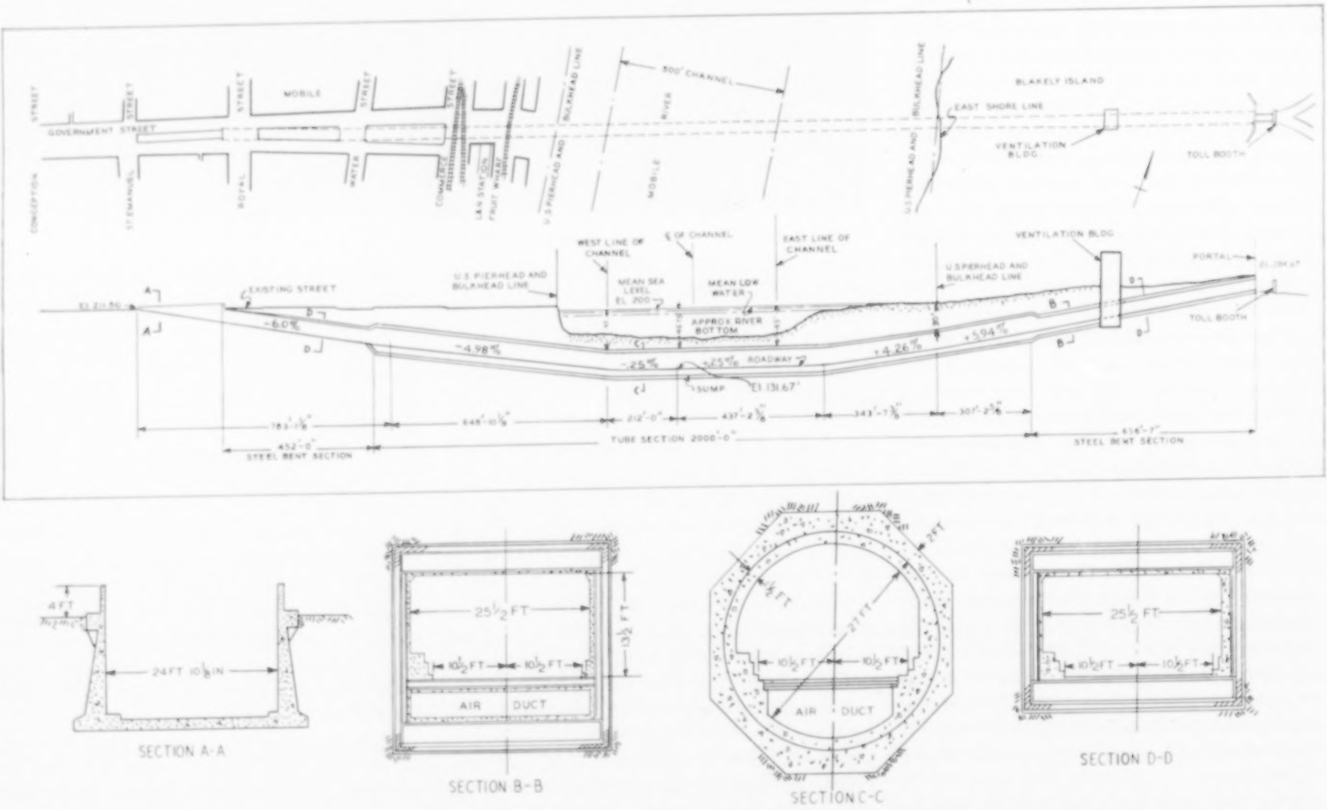
The first tube was placed at the Blakely Island side of the river; and its location was precisely established by survey shots from fixed stations on each side of the stream. Gallows frames, such as straddled the trench and sustained the first tube while it was being lowered to the prescribed depth and the required slope at its assigned key position, were also employed for handling and planting the six succeeding sections. This arrangement made it possible to hold each one in permanent alignment and to resist the transverse sweep of river currents the while.

At the time the tubes were sunk, there were two opposing steel bulkheads at each joint. These were removed progressively by burning them out with a torch, starting at the Blakely Island end and working westward. With two neighboring diaphragms thus disposed of, a permanent connection was made at that point by means of a binding ring of steel welded to adjacent ends. Before a section was finally cast loose from the gallows frame, and while hanging 2 feet above the bottom of the trench, the backfill was pumped in underneath it. When the sand was up to the bottom edge of the vertical sides, then the unit was released and its dead weight was sufficient to cause it to compact and to settle into the backfill a few inches. Next, the last of the tremie-poured concrete was placed between the circular and the octagonal shell of the tube, after which it was entirely covered with sand up to the level of the river bed.

On the Mobile side of the river the ground conditions adjacent to the bulkhead or pierhead line presented an added problem because of old cribwork, rock ballast from past shipping, and other refuse embedded there. It was therefore not possible to dredge a submerged trench in which to lower the last of the tubular sections. The situation was dealt with by constructing a sheeted trench landward of the bulkhead line. When the sheeting had been driven along the two sides, the trench was cleared and graded so that the seventh and the sixth tubes could be floated into the flooded trench and held in their assigned position while the fifth and last of the outlying sections was sunk. With that work done the several units were joined in turn—the sixth to the fifth and the seventh to the sixth, all three being enveloped with backfill when in their permanent locations.

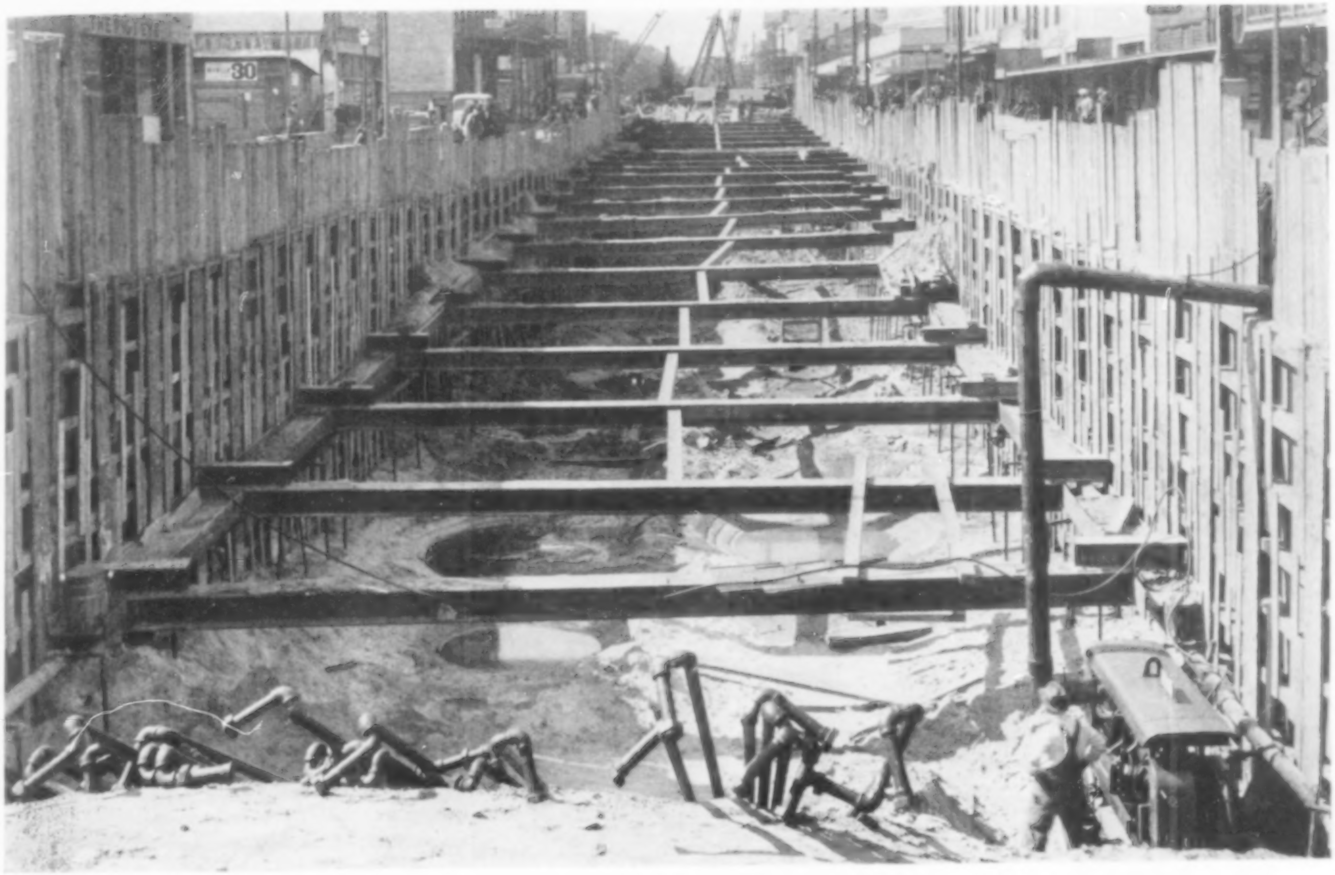
The landward end of section seven projected into a sheeted trench that was unwatered, thus permitting connection to be made with a transition section and the rectangular or box section of the tunnel. The units constituting the latter were constructed in the dry. Similarly, an open trench was provided on Blakely Island for work there on the transition section, the foundation of the ventilation building, and the box section of the eastern approach. While the eastern portal rises above the ground level, still the approach is covered with backfill to protect the tunnel from damage by hurricanes which sometimes sweep over Mobile Bay and raise the tide as much as 11 feet above normal high water. That portal is equipped with a hurricane gate which can be quickly closed and sealed, the leaves of the gate being high enough to shut out storm waters and waves that roll in upon that side of Blakely Island.

Apart from hurricanes, the entire region is subject to heavy rainfalls during certain months of each year, and the Bankhead


GOVERNMENT STREET
CONCEPTION STREET
ST EMANUEL STREET
ROYAL STREET
MOBILE
WATER STREET
COMMERCE STREET
L&N STATION
FRUIT WHARF
U.S. PIERHEAD AND BULKHEAD LINE
500' CHANNEL
MOBILE RIVER
BLAKELY ISLAND
EAST SHORE LINE
VENTILATION BLDG
TOLL BOOTH
WEST LINE OF CHANNEL
℄ OF CHANNEL
EAST LINE OF CHANNEL
U.S. PIERHEAD AND BULKHEAD LINE
EXISTING STREET
MEAN SEA LEVEL EL 200
MEAN LOW WATER
APPROX RIVER BOTTOM
EL 211.50
PORTAL
-6.0%
-4.98%
-.25%
+.25%
ROADWAY
+4.26%
+5.94%
SUMP
EL 131.67'
783'-1⅛"
648'-10⅛"
212'-0"
437'-2⅜"
343'-7⅜"
307'-2⅝"
452'-0" STEEL BENT SECTION
TUBE SECTION 2000'-0"
656'-7" STEEL BENT SECTION
4 FT
24 FT 10⅛ IN
SECTION A-A
25½ FT
10½ FT
13½ FT
AIR DUCT
SECTION B-B
2 FT
27 FT
SECTION C-C
SECTION D-D

PLAN, PROFILE, AND SECTIONAL DRAWINGS

In the midlength section, approximately 649 feet long, the tunnel has a slope of 0.25 per cent. From that part of the tube upward to the portals, the gradient reaches a maximum of 5.94 per cent on the Blakely Island end and 6 per cent on the Mobile end. The latter slope was necessary to avoid crossing another street at the lip of the Mobile ramp while placing the river portion at the depth prescribed by the army engineers.



OPEN-CUT RAMP

The cofferdam in Government Street within which the open-cut ramp approach in Mobile was constructed. When carrying the excavation in sandy soil below the ground-water level the opening was kept drained by well points.

Tunnel is provided with special facilities for the disposal of all water that may enter it from any cause by way of the open ramp in Mobile, flood water leaking through the hurricane gate at the Blakely Island portal, or normal seepage and water used for flushing purposes. Inside there are catch basins and sumps that are proportioned so that they can hold all rain flowing into the tunnel for a period of three quarters of an hour, even when precipitation is at a maximum of 4 inches an hour. These are designed to deal with the inflow while the pumping plant is, for one reason or another, temporarily out of service.

Power for operating the pumps, the ventilating fans, and the lighting installation will normally be supplied from plants at each end of the tunnel. But to meet an emergency when neither of these is available there is a generating set driven by a gas engine in the ventilation building. This standby can furnish enough energy for the lights and the pumps and for operating the fans at a rate that will assure some measure of ventilation. Should all three of these sources of power fail, then current for lighting purposes will be obtained from storage batteries.

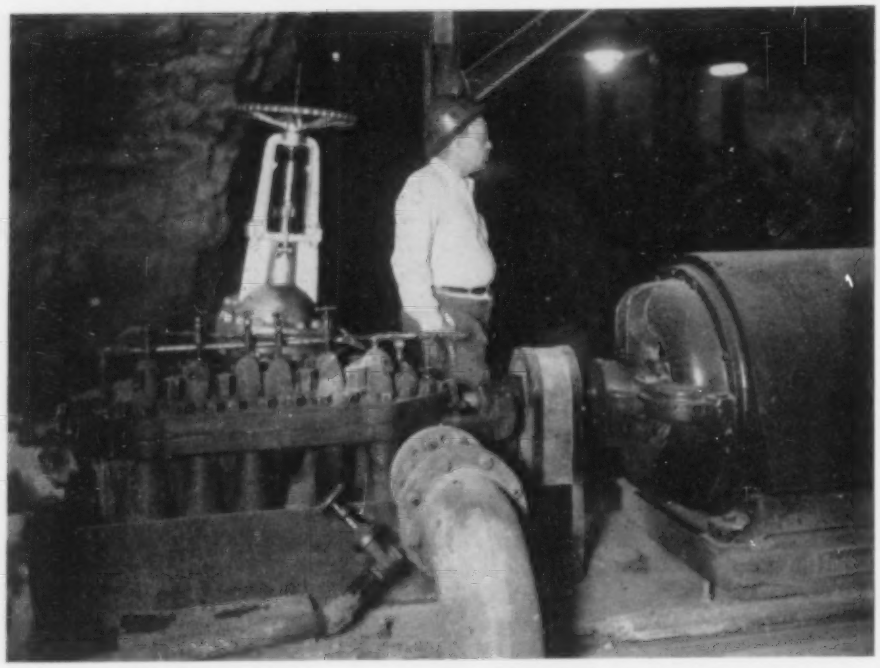
The Bankhead Tunnel is well illuminated by electric lamps that vary in their capacity and in their spacing in different parts of the structure. Near each portal, and for a distance of 110 feet in from that point, there are auxiliary ceiling lights that will be switched on only during the daytime. These are intended to help the eyes of entering drivers adjust themselves to the transition between bright sunlight and the much dimmer illumination inside the tunnel. The side walls and ceilings are finished with ceramic tile of a creamy white that effectively reflects the artificial light without glare.

The $4,000,000 that the tunnel costs was obtained through a PWA grant of $1,500,000 and a loan of $2,500,000 from the RFC (Reconstruction Finance Corporation). Mobile has issued 4 per cent 30-year revenue bonds for that loan; and tolls will be charged that will pay off the borrowed money by the time the bonds mature. While ground was broken on Government Street in Mobile with ceremony on December 29, 1938, actual work did not start on the project until July of the following year. The schedule calls for the completion and opening of the structure this autumn.

Relatively few of the residents of Mobile go northward from the city in the summertime. Instead, they escape the midday heat in the cool retreat of their homes and motor to the bayside in the evening, if they do not seek relaxation on the nearby wave-swept beaches of the gulf shore. The Bankhead Tunnel is therefore going to be much used by the people of Mobile, which is picturesquely dubbed the "Mother of Mardi Gras in America."

Wilberding & Palmer, Inc., of Washington, D. C., and Mobile, are the engineering and financial consultants for the undertaking, with Wayne F. Palmer, vice-president and treasurer of that concern, directly in charge of the engineering and contract work for the City of Mobile. The chief engineer is R.F. Schaefer, and the construction engineer is L.A. Ludwig. The project engineer for the PWA is E.H. Hopson. E.H. Burwell was supervising construction engineer for The Arundel Corporation, the principal contractor. Harvey & Quina, Pensacola, Fla., had the contract for the ventilation building for which the Rust Engineering Company, Birmingham, Ala., furnished the equipment. Miller Electric Company, Jacksonville, Fla., was the contractor for the electric equipment; and A.M. Lockett & Company, New Orleans, La., for the pumping apparatus. Steel for the work came from mills in Birmingham, Ala., and Alabama Drydocks & Shipbuilding Company, of Mobile, built the tube sections. Compressed air played a helpful part in operating utility hoists, concrete vibrators, chipping hammers, clay diggers, and other pneumatic tools used in the construction of the tunnel. The project was financed and undertaken only after a thorough traffic survey indicated that it would pay for itself.

Mine Pumping Now and in 1834



MINE DRAINAGE PUMP

This 6-stage centrifugal pump now does the work that once required the services of 300 men and 1,500 mules. It is installed on the bottom level of the San Francisco Shaft of the Proana Mine in Mexico and raises water 1,425 feet to a storage tank on the surface.

THE pump shown in the accompanying illustration was placed in the San Francisco Shaft of the Proana Mine in Mexico last spring for raising water from the 1395-foot level to the surface. The mine was opened sometime prior to 1800, and the pump represents the most modern and most efficient unit in a long succession of mechanical devices that have been employed for dewatering the workings.

In 1832, when the shaft was only 240 feet deep, the recorded cost of handling water was $300,300. Horse whims or *malacates* were then used. This apparatus consisted of a vertical cylinder or drum upon which a rope was wound when it was turned by animals, thus serving to hoist a kind of leather bucket, or *bota*, holding about 90 gallons of water. During the first part of the year, from 28 to 30 whims had to work continually to unwater the mine, and in September the number was increased to 39. As many as 300 men and 1,500 animals were needed for their operation.

A report for the year 1834 states that four mules were used on each *malacate*, the animals toiling only one 2-hour period each day. "The effect of a single *malacate*," it reads, "is small, as it can raise only 63,404 pounds (7,600 gallons) one foot a minute. It requires for its daily service ten men and forty animals, without counting any supplementary ones. The weekly cost of operating one of these machines, with forage at the ordinary price, is about $165, or $8,580 per year, but it rises as high as $12,000 in a bad year."

In that year was prepared an estimate of the expense involved in pumping with mechanical steam pumps, the figures being based on two units, each having steam cylinders of 60-inch diameter and 10-foot stroke and a pump cylinder with an 8½-foot stroke. It was computed that the first cost would be $250,000 and the annual operating cost $70,000. At that time the shaft was approximately 555 feet deep and the quantity of water handled amounted to about 650 gpm.

As mining proceeded, the shaft was sunk progressively until 1930, when it reached its present depth of 1,395 feet. The older part of the shaft was circular in section, and sometime subsequent to 1834 it was equipped with pumps of the Cornish type. Evidences of these are still to be seen. The pump recently put in is an Ingersoll-Rand 6-stage Class NT centrifugal unit. It is driven at 3,525 rpm. by a General Electric 350-hp. motor and has a capacity of 650 gpm. against a total head of 1,436 feet. Around 600 gpm. of water is now being handled, or a slightly smaller volume than in 1834. The water is pumped a total vertical distance of 1,425 feet into a surface storage tank holding approximately 500,000 gallons and is distributed from there to the mill or elsewhere, as needed.

It is impossible to make a parallel comparison of present-day pumping costs with those that have been mentioned because the depth of the mine and the area drained are greater than formerly and monetary values, wages, and other factors have undergone much change in the meantime. It is indicated, however, that the total pumping cost is less than one-seventh that of 1834.

The Proana Mine is one of the properties of the Fresnillo Company, whose principal office is in New York City. It is located in the State of Zacatecas in west-central Mexico. It is primarily a silver mine, but also produces some gold, lead, zinc, and copper.

Why a Flask of Mercury Weighs 76 Pounds

THE article on *Sidelights on our Weights and Measures* in our February, 1940, issue elicited an inquiry as to the reason why the standard unit of weight for mercury is 76 pounds. The following explanation of the use of this rather unusual weight has been advanced by Paul Hoffman, author of the article referred to. This explanation, Mr. Hoffman points out, is a deduction on his part and is not based on actual knowledge of the facts.

"As we all know, the mining of mercury ores was practiced first in Italy and Spain. The Spanish mines, particularly, go back to Roman Empire days and have probably always been the largest producers. We should, therefore, look to Spain for the origin of the weight standard. Now the unit of weight in Spain during the Roman Empire period was the *libra*, equaling about 0.72 English avoirdupois pounds. This was increased eventually—either gradually or by royal decree—to 0.76 English pounds, at which level it stood for probably several hundred years. Parallel with this, another 'standard' *libra*, equal to 1.01 avoirdupois pounds, developed. It was adopted by Portugal and most of the Spanish colonies in America, although changed by some of them to 1.02 pounds.

"The newer standard *libra* was subdivided into two *marcos*. Here will be noticed the connection with the old Danish weight unit, the *mark*, and the later German monetary unit. The older *libra* equaled 1½ *marcos*. The whole history is rather involved and confusing; but the pertinent fact is the existence in Spain, during the middle ages and until fairly recent times, of a standard weight unit, the *libra*, which equaled 0.76 pounds. The riddle is simply answered as follows: 100 of these old *libras*, or a Spanish hundredweight or *cental*, equals 76 English pounds. The flasks were made to contain a *cental* of quicksilver, and this has remained the trade standard."

EDITORIAL

FUTURE ALUMINUM SUPPLY

THE Tennessee Valley Authority has announced that John H. Walthall, one of its research chemists, has discovered a method of providing metallic aluminum from common clay. A pilot plant in the Muscle Shoals laboratory is turning out daily a ton of alumina, the oxide from which all commercial aluminum is derived. The process is not of much immediate significance so far as the United States is concerned because there are still available ample supplies of bauxite, a mineral of high alumina content that occurs in marketable quantities in half a dozen states. It does have future potentialities, however, for it assures us a supply of aluminum for all time.

Press reports did not divulge the details of the Walthall process, on which the inventor has been working for five years. Germany it is announced has been producing aluminum from clay for the past year, and it is possible that the two methods are similar. According to the American consul at Frankfort, the Germans decompose clay with sulphurous acid, forming aluminum sulphite. The latter is then reduced to aluminum oxide, or alumina, the acid being recovered and made available for reuse.

Aluminum is of importance now in that it is essential in the building of military aircraft and other war machines, where its combination of strength and light weight makes it particularly desirable. It is worthy of note in this connection that Germany has the largest aluminum-producing capacity of any country—about 200,000 tons annually. The United States made some 150,000 tons in 1939.

In view of aluminum's present position as a strategic war material it is interesting to recall that it is to Napoleon that we are mainly indebted for the development of the existing commercial processes of producing aluminum. In his time only a few milligrams of the metal had been isolated; but he recognized that it might be the means of making his army more mobile, and commanded the French chemist Henri Sainte-Claire Deville to find a way of producing large quantities of it inexpensively. Aluminum was then selling at $500 a pound.

Deville got the price down to $17 a pound; but the year's production (1859) was only 2 tons and Napoleon had to give up his idea. However, he did create an interest in the metal that eventually led to the discovery of the method by which the metal is now made to sell at less than 25 cents a pound. That method was discovered almost simultaneously by Charles M. Hall in the United States and by P.L.T. Heroult in France, the two men working independently. After Hall had vainly tried to find a purchaser for his process he found backing in Pittsburgh, and the Aluminum Company of America was formed. Its initial capital was $20,000.

SAFER NIGHT DRIVING

A GREAT deal has been done in recent years to give us safer highways. Broader roadways with better alignment, central islands between opposing traffic lanes, adequate markings and signs, superior surfaces and banked curves have reduced hazards on arterial routes. All these are engineering factors. Unfortunately, the human factor cannot be so easily brought under control. There will always be motor accidents so long as there are drivers and pedestrians that break laws, act without thinking, use bad judgment, or fail to take into consideration what the other fellow may do. However, even the knowledge that human frailties cannot be overcome does not deter efforts to make it as easy as possible to drive safely.

Many safeguards for daytime driving that can be applied in the open country are not feasible in cities. Congestion, narrow streets, and pedestrian traffic are inescapable handicaps in urban regions. Conversely, more can be done in municipalities than in rural districts to curtail accidents at night. This is because cities lend themselves more readily to lighting, which is generally recognized to be the foremost remedy for after-dark mishaps. City streets must be lighted in any event, and it does not involve much more trouble or expense to provide illumination that will promote safe driving and also meet the normal requirements of the residents.

Better lighting results in other benefits than safety, important though the latter is. Only one-third of the roadway traffic now flows at night. With freighting by truck increasing, effective utilization of the highway system calls for a greater movement of goods at night, with a proportionate reduction in the daytime when the number of pleasure cars on the roads is greatest. To increase night traffic without providing proper safeguards would, however, only send the night death rate skyrocketing, as was brought out a few days ago at the Ohio State Safety Conference.

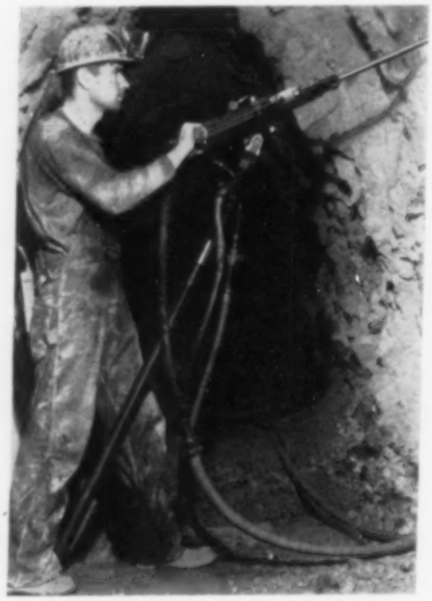
In the country as a whole, the one-third of the traffic that moves at night produces 60 per cent of the accidents, while in cities of more than 10,000 population the percentage is 65. One reason for this is that night city traffic is in most cases traveling under lighting systems that were designed fifteen or twenty years ago and that are no longer adequate.

That scientific illumination will reduce accidents sharply has been demonstrated in numerous cities, two of the foremost examples being Detroit, Mich., and Hartford, Conn. In 1936, on 31 miles of Detroit's main streets, seven persons were killed at night for every one killed in daytime. Modern lighting has cut the accident mortality rate to the point where it is as safe to travel those streets after dark as in daylight. In Hartford, the night-time accident frequency rate on fourteen streets is now one-twelfth of that that prevailed before an improved system of illumination was provided. Moreover, property damage has been reduced in two years by $78,000, which is $61,000 more than the cost of the better lighting.

Drill Runners Like New Jackhamer Mounting

JACKLEG is the name of a new Ingersoll-Rand air-feed mounting that is especially designed for driving flat or approximately flat holes with Jackhamers. It is said to support the drill, to absorb the recoil, and to feed the machine into the rock, in short, to relieve the operator of the brunt of the heavy work and to permit the employment of larger, faster-drilling Jackhamers in putting in holes of this kind. All he is required to do with his drill so mounted is to adjust the air throttle and to apply just enough downward pressure on the handle of the machine to keep it in line with the steel and to balance the lifting force exerted by the pneumatic feed of the Jackleg.

The mounting weighs 35 pounds, has a length, closed, of 56 inches, and a feed travel of 36 inches. It has a quick-locking bayonet connection by which the drill can be easily removed when it is needed for driving down or toe holes. By means of a universal joint at the top, the Jackhamer can be rotated sufficiently to free stuck steels; and by placing the foot of the Jackleg close to the breast and thus reversing the direction of the feed, badly stuck steels can often be released.



It is reported that the mounting has increased footage as much as 50 per cent in some cases; that its use lessens wear on chuck bushings and fronthead parts and therefore upkeep costs; and that it cuts down the accident rate because the miners can do the work without the fatigue incident to holding up a tool weighing from 30 to 55 pounds, pushing it into the rock face, and exerting the 104 pounds pressure necessary to keep it there and to maintain drilling speed. An illustrated folder—form 2690—with full details about the Jackleg can be obtained from the main office of Ingersoll-Rand Company at 11 Broadway, New York City, or from any of its numerous branches.

Metallic Lubricant for X-Ray Tubes

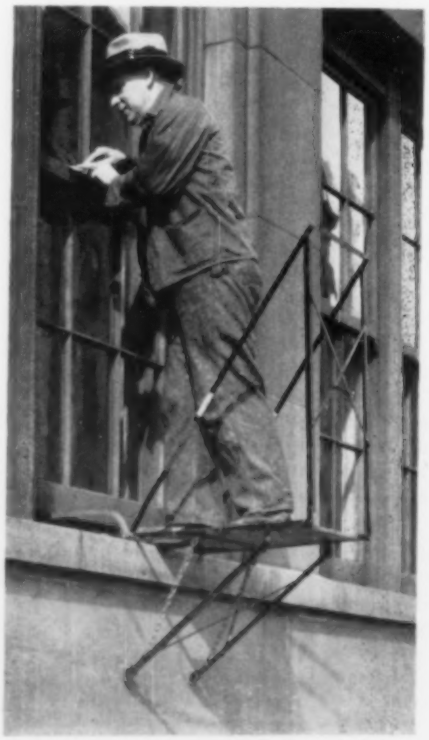
ENGINEERS of the General Electric X-Ray Corporation have found that a thin coating of metallic barium is highly effective as a lubricant in a special type of X-ray tube in which the anode is rotated at high speed. The tube is used for high-power, high-speed diagnostic work and heretofore has had to be operated without lubrication. By reason of the high vacuum demanded in the case of equipment of this kind, ordinary grease or oil is out of the question because any vaporization of either of those lubricants destroys the vacuum and renders the tube useless. Vaporization of metallic barium, on the other hand, places a film on the steel ball bearings of the rotating anode and greatly reduces the friction. The anode is an extension of the shaft of the rotor of an induction motor which is located immediately outside of the X-ray tube. The latter is completely sealed.

According to the *Journal of Applied Science*, the use of barium as a lubricant has made possible a tube that not only functions much more quietly but one in which the bearing life is much longer. Let us cite a case in point. Under ordinary conditions, an anode bearing was found to have a sound level of 87 decibels, a speed of 3,100 rpm., and a coasting time of twelve seconds. Half a minute after a barium film had been applied, the sound level was reduced to 68 decibels, the speed increased to 3,560 rpm., and the coasting time extended to 480 seconds. Under the normal operating temperature of the X-ray load, the film lubricates an anode bearing for 50 to 100 hours of rotation. As the average time of rotation per exposure is about five seconds, this corresponds to from 36,000-72,000 exposures of the sort usually made in studying the chest or heart.

In the course of the investigations, tests were made with other metallic films, including chromium, aluminum, magnesium, and zinc in air, and while barium was best suited for X-ray work, it has been suggested that they might be applied to advantage in the industrial field under similar circumstances where the use of organic lubricants is undesirable.

SOFT AND FLEXIBLE

This service-station attendant is using a gasoline hose with a synthetic-rubber nozzle that is guaranteed, among other things, not to break and not to scratch your car. Molded into its outer surface are sixteen ribs which permit continual venting during filling. In four of these ribs are brass-wire coils which, together with the conductivity of the synthetic rubber, provide a metallic ground and prevent dangerous sparks. The new nozzle is 12 inches long and has a nominal inside diameter of ¾ inch. It is being offered by The B. F. Goodrich Company after twenty months of practical use and has passed the rigid tests of the National Board of Fire Underwriters.



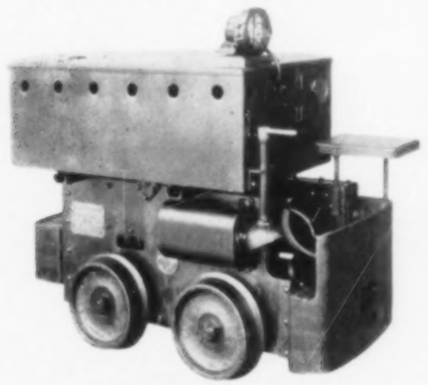
SURE FOOTING

Capable of supporting 500 pounds, this folding scaffold should make window cleaning a safe occupation. The iron frame is fitted with a pair of clamps that are attached to the window sill on the inside while a pair of braces support it against the outside wall. It weighs 22½ pounds and has been introduced by the Green Duck Company under the name of Save-ty Window Scaffold.

Industrial Notes

According to a report of the U. S. Department of Commerce, Italy's supply of vanadium for steel alloys is being supplemented annually by about 50 gross tons of vanadium-bearing concentrates obtained from naphtha soot collected from the smokestacks of ships and industrial plants.

An improved 1½-ton storage-battery trammer locomotive was the main feature of the General Electric Company's exhibit at the Seventh Annual Metal Mining Convention and Exposition held recently in Colorado Springs, Colo. Built especially to meet the needs of metal mines with several haulage levels, it is sufficiently compact to enter standard cages and to negotiate passages with limited clearances. Without bumpers it is 46 inches long and 33 inches wide. It has a totally inclosed motor, antifriction bearings, a controller which gives four speeds forward and reverse, and extra interchangeable battery boxes.



Motor generator sets pyramided to save floor space are being built by Allis-Chalmers Company in sizes up to and including 10 kw. The exciter is mounted on the induction motor, which is mounted on the generator, each unit of the assembly being self-contained and easily removable. Drive is effected by Texrope V-belts from the motor shaft.

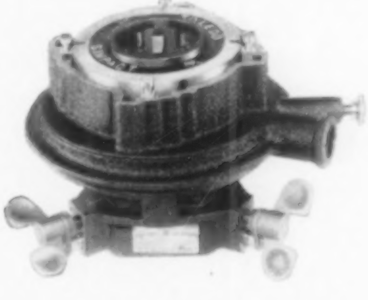
Stewart R. Brown Manufacturing Company has introduced an explosionproof extension lamp with a capacity of 100 watts, or two and a half times the power of any portable lamp of equal weight listed by the Underwriters. It has a safety grip of molded plastic, an extra-heavy sparkproof hook and guard, an automatic circuit breaker that shuts off the current when the globe breaks, and a 1-piece guard that must be in position before the lamp will burn.

For use as a signaling device at points where there is danger of fire from spontaneous combustion, overheating of electric motors, etc., the General Fire Truck Corporation has developed a bomb called Life-Guard. It is designed to go off automatically at a temperature of 160°F., and gives two loud reports a few seconds apart. Blank cartridges are used, and are fired into bronze combustion chambers. The unit can be reloaded indefinitely.

By what is claimed to be a greatly improved method of manufacturing quartz-glass tubes, the raw material is fused in molybdenum crucibles with an orifice of the same metal and is heated by tungsten filaments. According to the American Vice-Consul at Dresden, Germany, the molybdenum is not corroded by the molten quartz, and the required furnace temperature of 3,632°F., is obtained without difficulty. The forming tube is prevented from tapering by a stream of gas, and a special drawing machine, together with a system of slide rolls, pulls the finished product away from the crucible. Endless tubes 0.4 inch in diameter are being made at the rate of 98.5 feet an hour, a special knife being used to cut them into the desired lengths. Work is now in progress on equipment for 1.57-inch-diameter tubes.

The accompanying illustration shows a pressure oil flusher and dispenser for use in flushing out and relubricating the bearings of various types of machinery, thus removing particles of dirt, grit, or metal. The apparatus is called Port-o-Flush, and is manufactured by J. A. Honegger. It holds one quart, and will handle oils of any viscosity from kerosene for flushing out bearings and transmissions prior to oiling to 600 W transmission oil for gear-reduction drives. It is claimed that flushing and oiling are accomplished instantly and thoroughly because the liquid is introduced at 60 to 100 pounds pressure per square inch. In the unit illustrated, this pressure is obtained by inserting a carbon-dioxide supercharger shell into the angular holder at the upper left. The pressure forces the oil into the bearings and causes it to burst there into myriads of molecular globules that bombard all interior surfaces. The device can also be furnished with an attachment in the head to permit the introduction of compressed air from a plant line or from a hand pump.

Toledo Pipe Threading Machine Company has placed on the market what it describes as a sensational new self-contained 1- to 2-inch ratchet threader. The Simpact "cuts perfect tapered threads" with high-speed steel dies that are quickly changed from one size to another by pushing size-selector buttons and slipping the dies in the proper steps. The dies are deep throated and may be resharpened many times. Positive and easy centering of the tool on the pipe is assured by a rear gripping device with three broad-faced chuck jaws, graduated guide posts, and large wing-head thumb screws. The Simpact is operated by a 24-inch, tubular, steel handle.



Considerable interest attaches to a recent announcement of the American Window Glass Company that it is making sheet glass that transmits the health-giving ultraviolet rays and costs about the same as ordinary window glass. It is said to be virtually free from waviness and distortion, giving it the appearance of plate glass, and is white instead of green in color. The new product is called Lustraglass.

Round, hexagonal, and octagonal ingots can be cut up like cheese by what is known as the Craven ingot-slicing machine. It is designed to take ingots having a maximum length of 8 feet and a maximum diameter or dimension across corners of 24 inches, and to cut each into eight slabs at one setting. The slicing tools are adjustable, the minimum width of slab being 5½ inches. Exclusive of the electrical equipment, the machine weighs approximately 30½ tons and is driven by a 100-hp. motor.

A liquid sealing material for curing concrete is being offered by Solvents & Plastics Company under the name of Aquastatic. It is applied by brushing or spraying and dries within approximately twenty minutes, forming an elastic film that keeps the concrete moist. A gallon covers from 250 to 300 square feet, and one coat is said to serve the purpose of fourteen days of water curing. The preparation oxidizes gradually, exposing the concrete surface; but it can be removed by the use of wire brushes.

As a precaution primarily against dust explosions in collieries, the Illinois Bell Telephone Company has developed a telephone that will serve equally well in powder plants, gasoline refineries, grain elevators, etc., where anything that might cause a stray spark is to be avoided. The instrument is in the shape of a drum in which all electrical parts such as wires, coils, and breakers are encased airtight and from which the mouthpiece and ear receiver protrude. The drum is of metal and sealed with rubber.

It is reported that prospecting in the Kola Peninsula by a Soviet woman geologist has resulted in the uncovering of what are said to be inexhaustible supplies of a rare mineral, called loparite, containing columbium titanium, and tantalum. Steps are already being taken to explore the deposits. The finding there of a new mineral with a high beryllium content also has been announced. The latter has been named chkalovite in honor of the well-known Soviet aviator.

One of the few vital materials for which the United States is dependent on foreign sources of supply is tin, and the following announcement made recently by the Standard Steel Spring Company in the Pittsburgh District is therefore of considerable significance. That company has developed what is called nickel-tin, which consists of half nickel and half tin applied to steel sheets in layers in the order named by an electrolytic process known as corronizing. The cost of production of both materials is said to be the same; but by the new plating method the consumption of tin is cut in two.

Educational, industrial, church, and other organizations having a 16-millimeter sound projector may obtain for exhibition without charge a new talking motion picture produced by E. I. du Pont de Nemours & Company telling the story of neoprene. This synthetic rubberlike material is made from coal, limestone, sand, and water, and is taking the place of natural rubber in many commodities essential to our national well-being. This timely 20-minute film shows how neoprene is made, explains its chemical formula by means of animated cartoons, and shows interesting tests and applications of the material. Bookings may be arranged through the Rubber Chemicals Division of the du Pont Company, Wilmington, Del.

You can't judge

PISTON RINGS *by looks*

. . . any more than you can judge tires.

ONE tire is good for only 15,000 miles; another is good for 40,000 miles. Yet you can't tell the difference by looking at them. There are invisible ingredients in the good tire that account for its vastly superior performance.

The same is true of piston rings. You can't judge their performance ability by looks. The marked superiority of COOK'S Rings in the vital matter of performance originates in the fact that they are engineered especially to meet the service requirements of the specific engine or compressor in which they are to be used—a procedure made possible by Cook specializing in the manufacture of custom made rings for the equipment builders and operators who appreciate that performance counts, and that the best rings are ultimately the most economical to use.

The best proof of the superiority of COOK'S Rings is the fact that many companies have turned to COOK'S Rings for their severe service units while confining the use of ordinary rings to machines on which demands are light.

But more and more engineers are beginning to realize the slight added cost of COOK'S GRAPHITIC IRON Piston Rings is low-cost insurance against the occasional trouble that develops from impaired lubrication, presence of extraneous matter or from any one of a number of causes that result in costly shutdowns and repairs.

★ ★ ★ ★

The full story behind COOK'S Rings is yours for the asking. Write for it today and learn about COOK'S GRAPHITIC IRON—COOK'S "TINIZING" process which provides preconditioned wearing surfaces—and COOKMET—all exclusive in COOK'S Rings and which have contributed so much toward improving engine and compressor performance.

. . . It pays to use

COOK'S GRAPHITIC IRON PISTON RINGS

C. LEE COOK MANUFACTURING CO.
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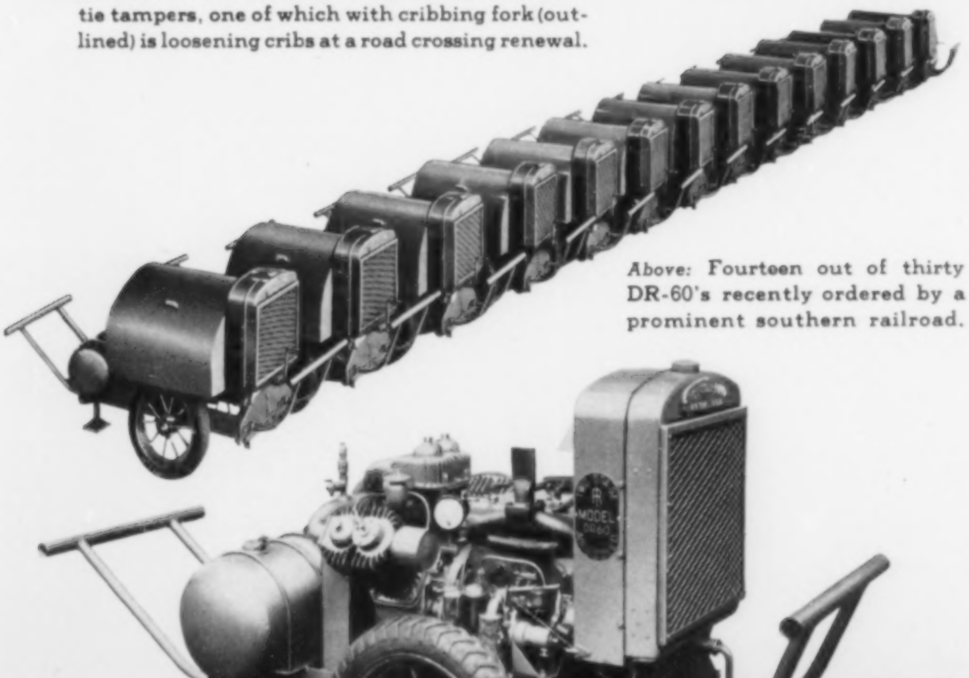
New York Cleveland Los Angeles Baltimore **LOUISVILLE, KY.** Chicago Tulsa New Orleans San Francisco

GIVE EACH OF YOUR SECTION GANGS A DR-60 SPOT TAMPER

The DR-60 shown above is operating five MT-3 tie tampers, one of which with cribbing fork (outlined) is loosening cribs at a road crossing renewal.



Above: Fourteen out of thirty DR-60's recently ordered by a prominent southern railroad.

The DR-60 follows the work without interrupting traffic. It is also widely used for operating many combinations of other air tools.

The DR-60 is an easily transported, lightweight, "off-track" two-stage air compressor, that was designed especially for railroad use.

It will furnish more than enough air to operate 4 MT-3 tie tampers plus one cribbing fork.

You will want to investigate this latest development in tie tamping equipment.

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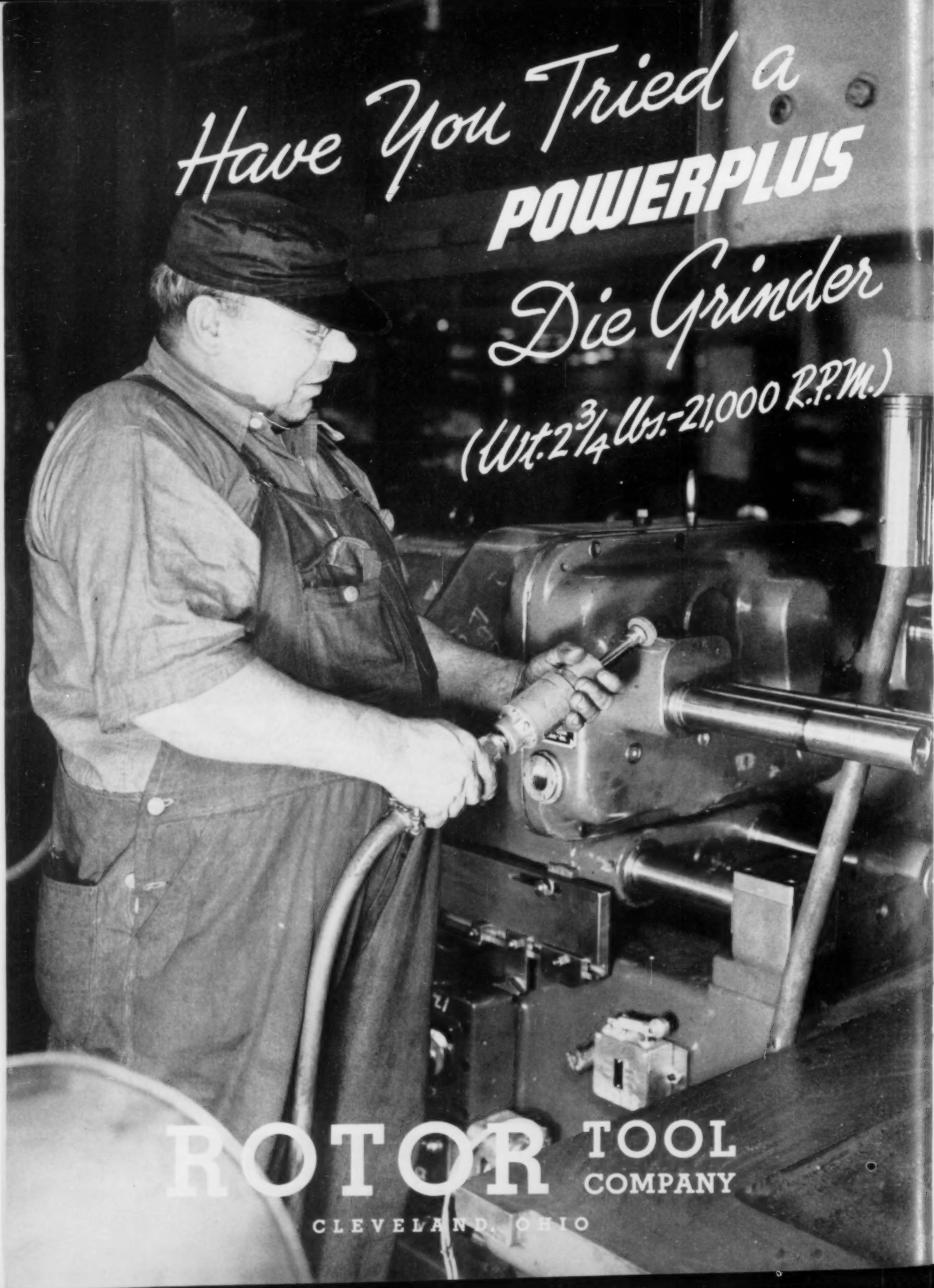
Have You Tried a
POWERPLUS
Die Grinder
(Wt. 2 3/4 lbs. - 21,000 R.P.M.)
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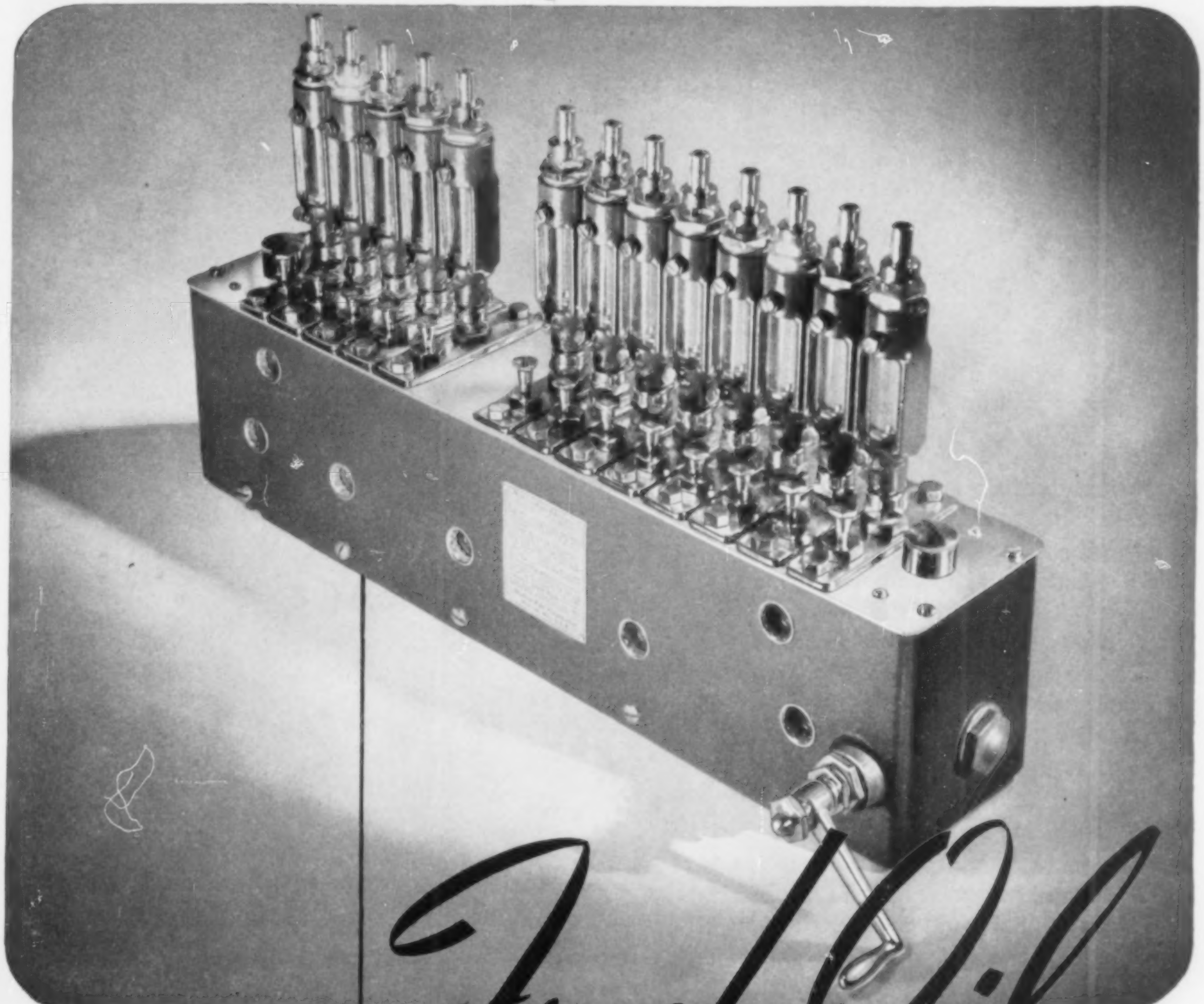
CLEVELAND, OHIO

MADISON-KIPP LUBRICATORS

. . . *more and more* applications as Standard Equipment *because* . . .



Fresh Oil . . .

Year after year for the past ten, twenty, thirty years and longer Madison-Kipp Fresh Oil Lubricators have been standard equipment on America's highest grade compressors, work engines, and machine tools.

Fresh Oil by the measured drop from a Madison-Kipp Lubricator is without question the most dependable method of lubrication ever developed. It is significant to know that most of the manufacturers who equip with Madison-Kipp Lubricators are undisputed leaders in their respective fields. Correct lubrication engineering is of vital importance to the service and life of any machine. Madison-Kipp specialists will be glad to assist in solving original equipment oiling problems. Write today for further information.

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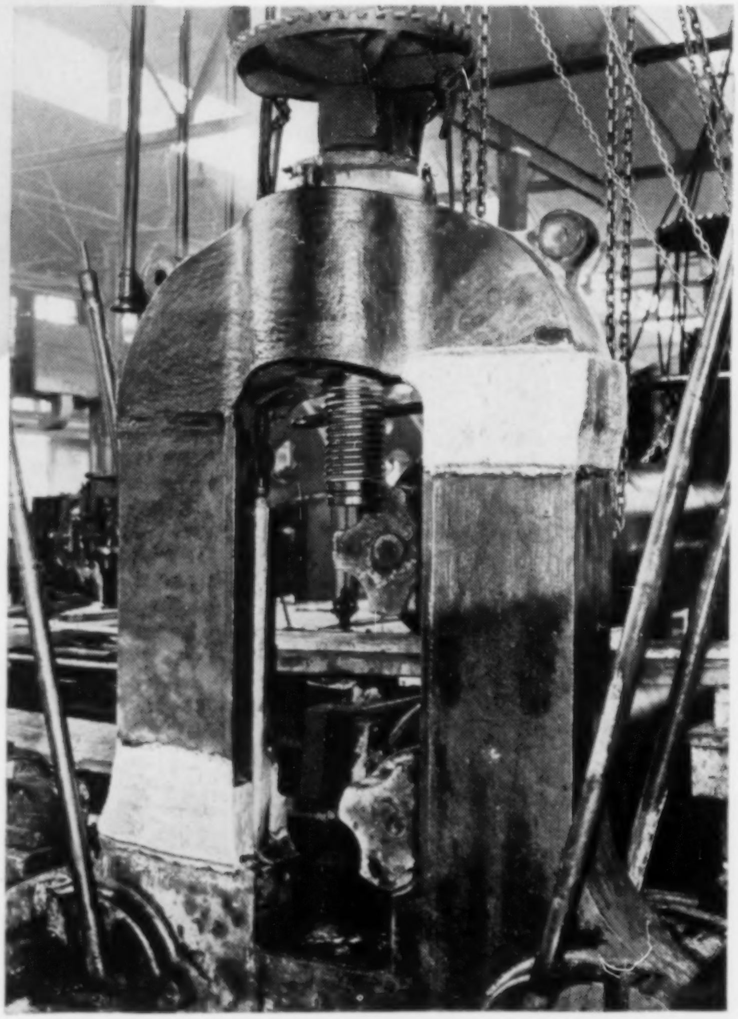
MADISON-KIPP CORPORATION, 202 Waubesa St., Madison, Wis., U. S. A.

How strong is a 400-lb. Tobin Bronze weld? How quickly can it be made?

The story of the repair welding of this 15-ton roll housing reveals the answers to these important questions . . .



LAST March 8, this huge housing on a 33″ rolling mill cracked resoundingly and thundered to the floor. Production orders were heavy on this particular mill and a replacement could not have been made for eight or nine weeks. To save time, two temporary repair-welds with Tobin Bronze were tried. Welders, working steadily in two shifts, used 400 lbs. of Tobin Bronze ⅜″ welding rods for each weld; consumed only nine days to complete the work. On March 17 the housing was back in place ready to go . . . So much for how quickly welds of Tobin Bronze can be made.

Production was resumed, the plant superintendent hoping that the repaired housing would stand up under terrific operating pressures of the rolls until a new casting could be obtained. Six months later that mill was still rolling its quota of metal. *What's more,* during this period, a roll neck broke in the housing. The abnormal stress that brought about the fracture in the heavy roll was absorbed by the welded housing with no sign of failure. Such service is proof positive of the high strength of properly made Tobin Bronze welds in cast iron.

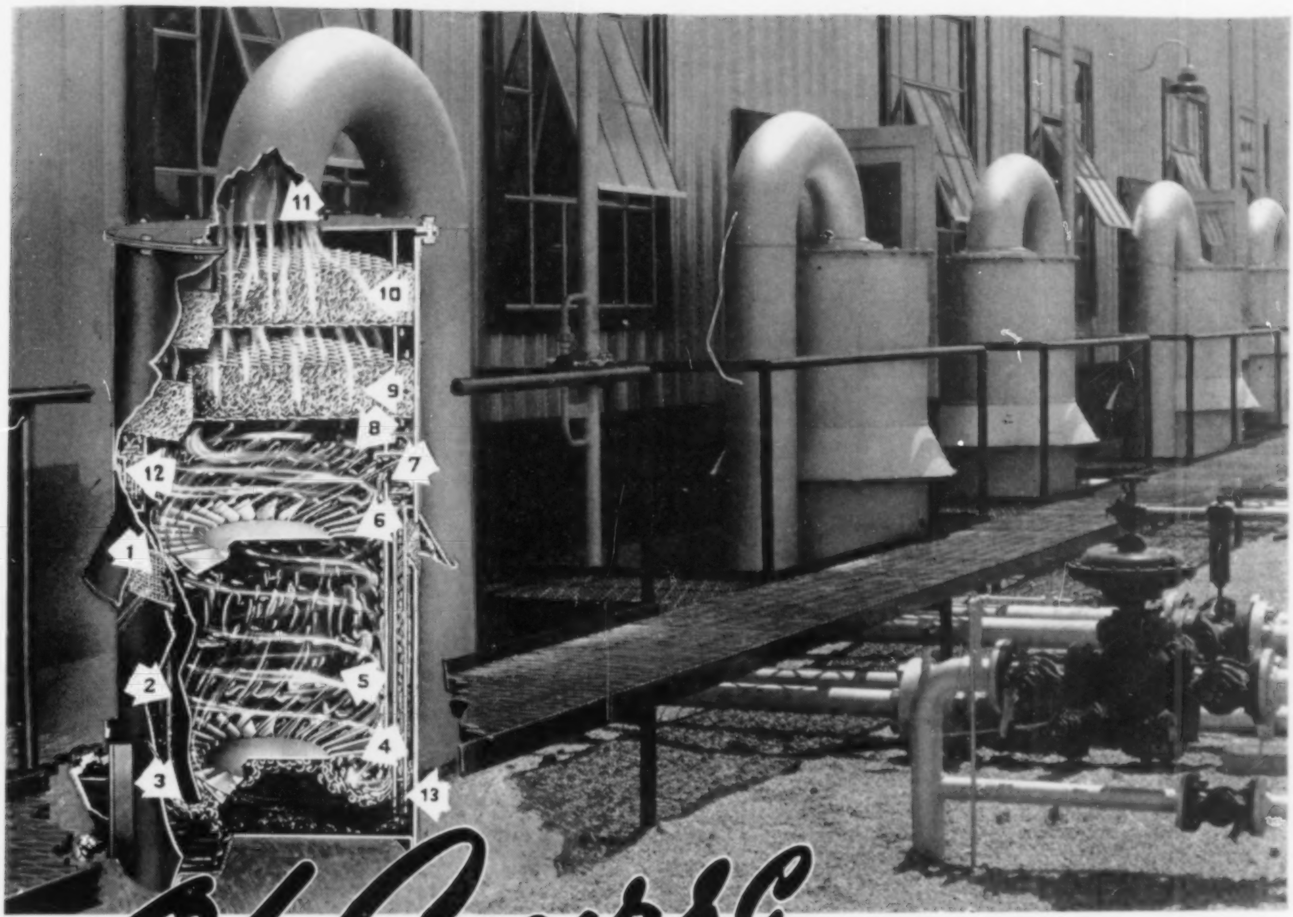
Tobin Bronze welding rods are stocked by all leading supply houses. Make sure that when you buy Tobin Bronze it bears the trade-mark "Tobin Bronze—Reg. U. S. Pat. Off."—only then you will be getting the genuine. 40115

ANACONDA from mine to consumer

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Company



Of Course THE WORLD'S LARGEST CHOSE THE WORLD'S BEST

HERE IS HOW IT OPERATES

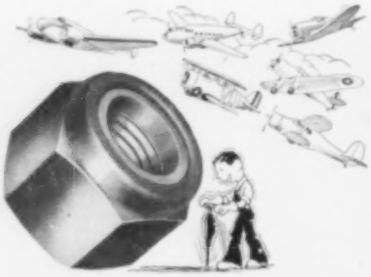
Dirty air enters under rain shield and passes thru bug screen (1), then downward thru space (2) between inner and outer cylinders. At (3) it impinges against oil, depositing heavier dust particles, picks up oil and passes upward thru vanes (4) which impart a whirling motion to mixture. In chamber (5) the whirling air and oil are thoroughly mixed and the centrifugal action throws a large portion of dust against oil-coated walls of inner cylinder. The air-oil mixture then passes thru vanes (6) which impart a still faster whirl, throwing it outward by centrifugal action. At top of cylinder (7) is an enlarged chamber into which most of the oil and dirt are thrown from the air stream. The pre-cleaned air then passes upward thru orifice (8) and thru double filter cells (9) and (10) leaving the cleaned air at (11) to pass into the engine or compressor. The continuous flow of oil keeps the filter cells thoroughly washed so that any collected dust is carried away. Oil which drains from the filter cells passes downward thru pipes (12) and (13) to the oil reservoir. Here the dirt settles out and the oil recirculates.

In the world's largest field stabilization, gasoline recovery and pressure maintenance plant, owned by Continental Oil Co., 22 Cycoil Oil Bath Air Filters protect the engines against destructive abrasive dust and keep down operating and maintenance cost.

The new Type W Cycoil, illustrated in cross section, shows its unique continuous self cleaning operating principle. Write for Bulletin No. 130C and complete installation and engineering data.

AMERICAN AIR FILTER CO., INC.
INCORPORATED
664 Central Ave., Louisville, Ky.

AMERICAN Cycoil OIL BATH AIR CLEANER



PNEUMATIC ROCK DRILLING

was the ground school for Elastic Stop Nuts

Not until they were proved in the most gruelling industrial service, were Elastic Stop Nuts offered for aircraft. That was in 1927 when they had made good on rock drills where the vibration is the most severe known in any field.

- Now, these nuts are in their fourteenth year of successful use on aircraft . . . applied to major and secondary fastening jobs on every American military and transport plane, as well as on most foreign planes.
- Completing the cycle, industry has recognized their record in the air by adopting them for all classes of equipment, where, as on aircraft, they are promoting safety, speeding up production, and reducing maintenance costs.

A 56-page Catalog and Data Book contains a graphic explanation of the Elastic Stop principle, test and application data, and a complete listing of the nuts. • Write for a copy.

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THE NUTS WITH THE RESILIENT NON-METALLIC LOCKING COLLAR

Elastic Stop SELF-LOCKING NUTS

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OIL BATH FILTER-SILENCER

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against dust and grit—plus
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Air-Maze Model 8N, Oil Bath Type Filter-Silencer Unit

More than a silencing device "added on" to a filter. Has highly efficient acoustical chamber as an *integral part* of the famous Air-Maze Oil Bath filter. Provides 99.83% protection against dust and grit with automatic oil washing action and, at the same time, eliminates all objectionable intake noises. Extremely low pressure drop. Easy to install and service. Write today for bulletin FSP-89.

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AIR FILTERS FOR EVERY INDUSTRIAL APPLICATION

FOR TOP PERFORMANCE USE WAGNER MOTORS ON YOUR PUMPS AND COMPRESSOR

Wagner type HP explosion proof motors driving Ingersoll-Rand Cameron pumps in a large Mid-western oil refinery.

This is only one of the many plants throughout the country where Wagner motors are giving dependable trouble-free service. In one building alone of this large plant there are thirty Wagner motors driving pumps and compressors. The wide-spread use of Wagner motors in this plant is a testimonial of their reliable performance.

You too can be assured of reliable performance, low maintenance, and continuity of service on your pumps and compressors by specifying Wagner motors. Whether buying new equipment or replacing motors on equipment you have, insist on Wagner motors. Send for free bulletins MU-177 and MU-182.

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Maxim MU1 Silencer on exhaust of Skinner Uniflow Steam engine.

MAXIM SILENCERS COVER THE FIELD

- For Steam Discharges (High or low pressure)
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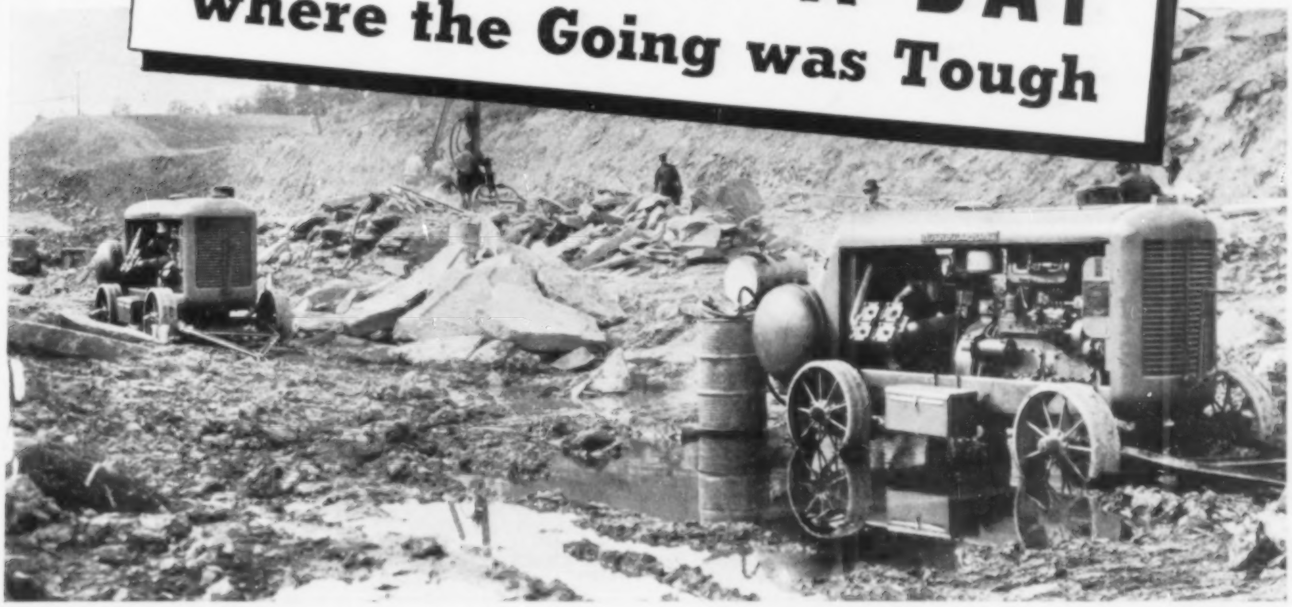
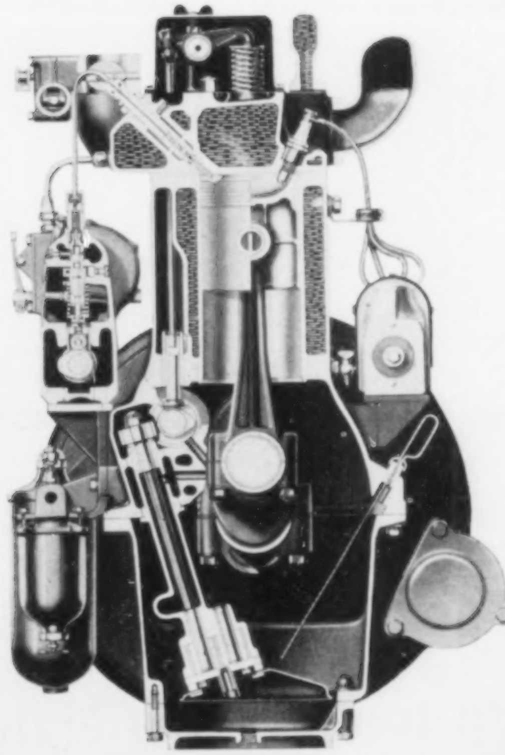


WAUKESHA
ENGINES



WAUKESHA ENGINES Power ALL I-R Portable Compressors

On the famous Pennsylvania Turnpike . . . where the going was plenty tough and contractors were working against time . . . Waukesha-powered Ingersoll-Rand Portable Compressors were on the job *24 hours every working day.*

There's a record of dependable power and performance for you—the result of a *unified power plant.* In every I-R Portable the engine and compressor are built into a single unit. That means reliability and economical, trouble-free operation.

Not only have Waukesha Heavy-Duty Engines powered I-R Portables for the past 27 years, but they are giving equally impressive service on thousands of shovels, cranes, hoists, pavers, mixers, graders, surfacers, tractors, and other industrial machines.

It will pay you to standardize on Waukesha Engines. Sizes from 10 hp. to 350 hp. for gasoline or oil operation. Write for Bulletin 1079.

WAUKESHA MOTOR COMPANY
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No One Pounds My Drills!!

This Helps Me Get The Most Out Of Them

Before I'd had much drilling experience, I used to stick a lot of steels. They slowed me up. I didn't like this and to free them I used to pick up a piece of drill steel or a wrench and hammer my machine. This was especially true when I made my setups too close to the face because the drill was the only thing I could hit.

One day, I cracked the chuck housing. Other miners told me about denting cylinders and causing different failures.

I realized then that the rough treatment of drills didn't pay so I stopped it. Today none of the drills in my headings are pounded!!!

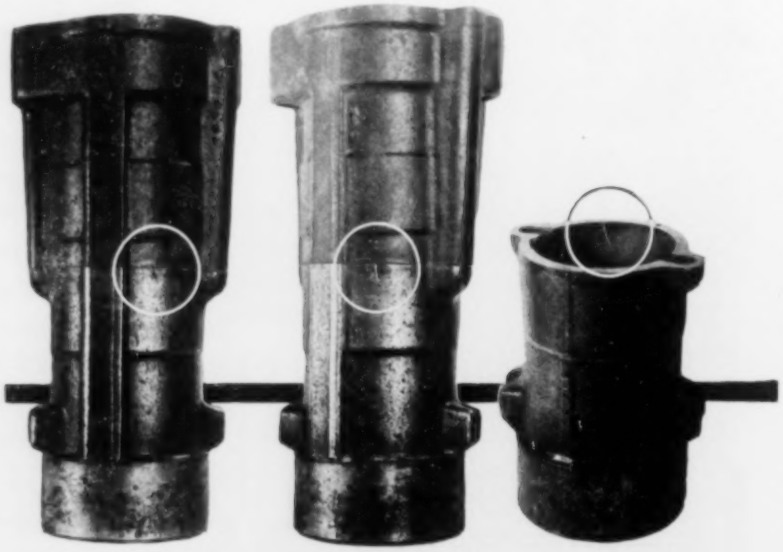
The Rough Treatment of Drills Causes Delays and Increases Drilling Costs

1. Hammering the fronthead of drills causes chuck housing breakage.
2. A heavy blow on a drill cylinder will dent it. This sometimes stops the travel of the piston, and often cracks the cylinder.
3. Rough treatment of drills leads to many uncalled for replacements.

Please Note

This is one of a series of talks intended to create a greater awareness of operating conditions, so that the users of rock drills can more nearly get out of their machines what the Ingersoll-Rand Company's designers, engineers, and metallurgists have built into them. *Reprints of this talk or of any of the series may be obtained for your bulletin boards, for use as payroll stuffers, etc.*

IR



These pictures from left to right tell a story of rock drill abuse. The circle on the first drill cylinder indicates a dent caused by a blow. When magnafluxed, this area was also found to be cracked. The third illustration shows the crack on the inside of the cylinder. This is often the result of a heavy blow.

891-5

Take Care of Your Rock Drills and You'll Increase Your Profits

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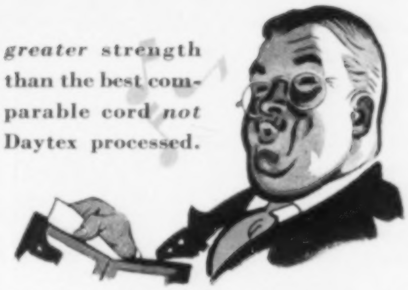
SERVICE CENTERS and STOCKS the WORLD OVER

BECAUSE Dayton V-BELTS HAVE LESS STRETCH

—YOUR POWER DOLLAR HAS MORE

Because Dayton V-Belts with Daytex Cord in their neutral axis section have *less* stretch, they are cooler running and they stand up *longer* under the strain of constant high speed flexing. And that means that your power dollar stretches farther to give you lower cost per-month-of-service.

Wherever power is used you will find proof of the fact that Daytex Cord *does* have *less* stretch, *longer* life and *greater* strength than the best comparable cord *not* Daytex processed.

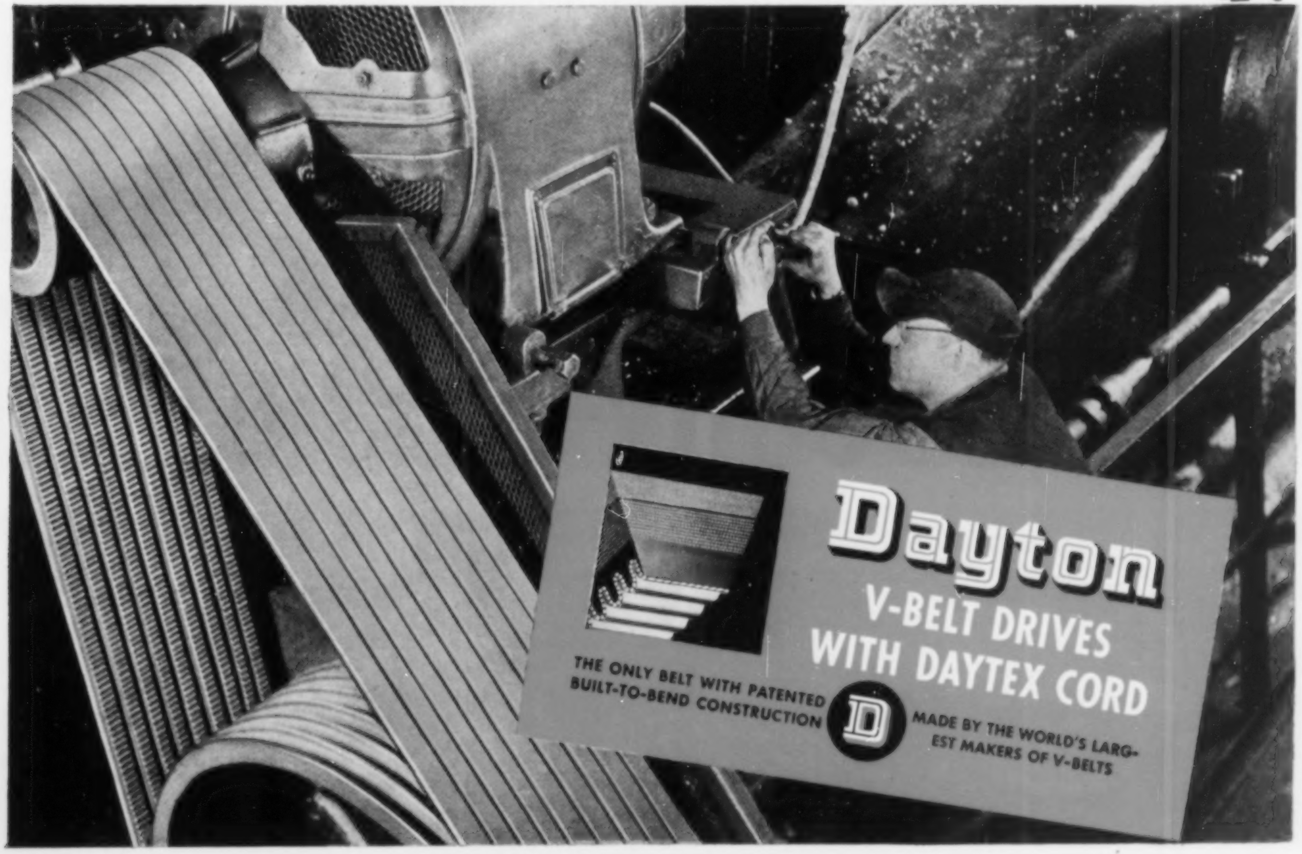


In thousands of field applications—in all climates and under all conditions, cooler running Dayton V-Belts deliver more output at less cost. What's more, they save time, machinery—and reduce adjustments to a negligible minimum.

Dayton V-Belts are outstanding in basic design because they are the only belt with patented built-to-bend construction. They work on short centers—they save space—maintain machine speed and prevent power waste. Ask your local Dayton distributor for catalogs, data and "The Picture Story of Daytex Cord."

* * *

THE DAYTON RUBBER MANUFACTURING CO.
DAYTON, OHIO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V-BELT DRIVES
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CLEAN AIR + RIGHT OIL + MINIMUM FEEDS =

Efficient Air Compression!

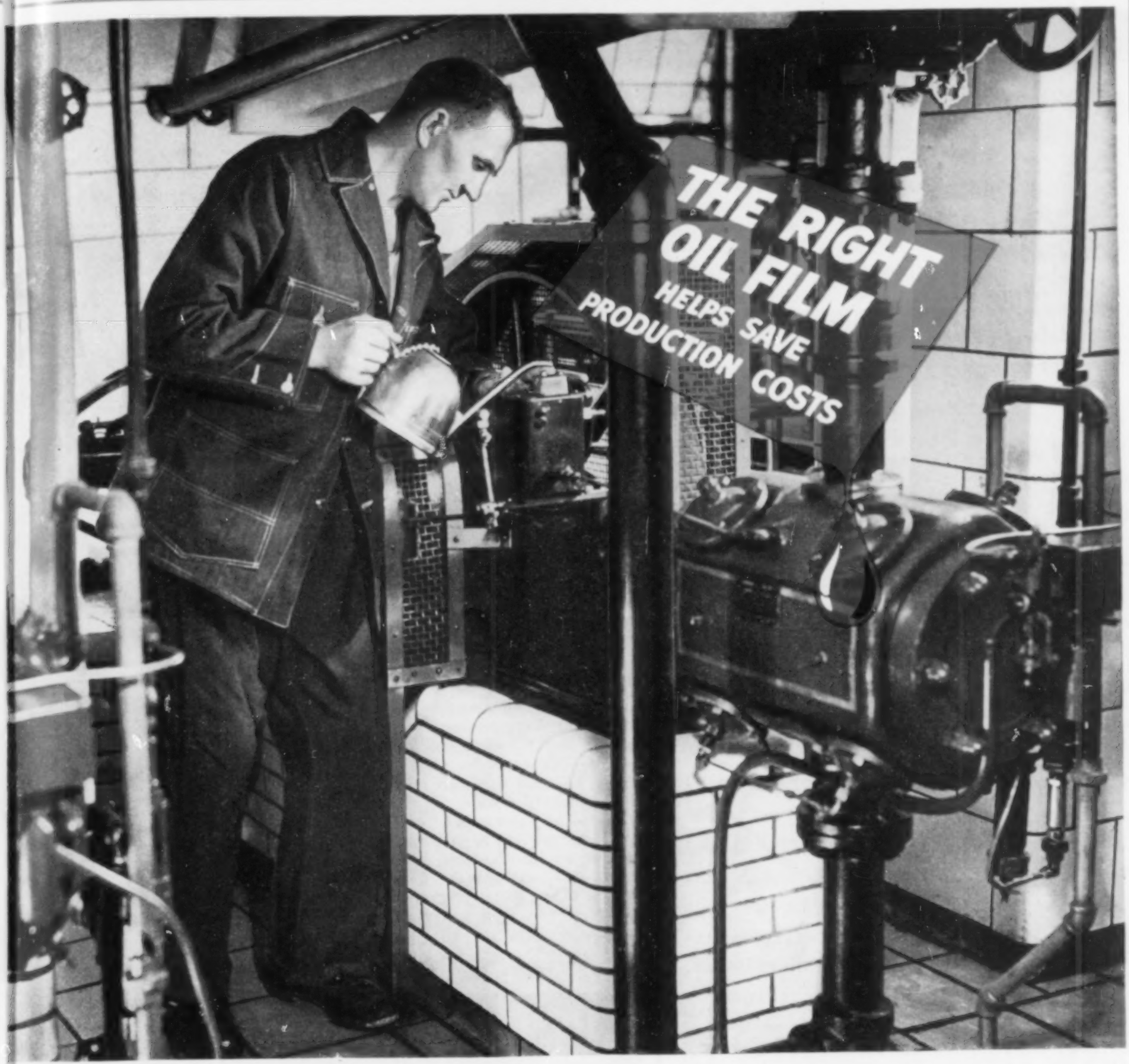
THAT'S THE TESTED FORMULA for smooth-running compressors. The Socony-Vacuum Man will help work out this formula for you. He will work with your men in placing air sources and filters properly . . . recommend the right Gargoyle D. T. E. Oil . . . suggest ways of securing minimum feeds.

CALL IN Socony-Vacuum for

You'll Profit from these "Exclusives"

☞ **SKILLED LUBRICATION COUNSEL** of a Socony-Vacuum man backed by 74 years' experience . . . the greatest in the Petroleum Industry.

☞ **A COMPLETE LINE** of Lubricants . . . the scientifically correct lubricant for every type of machine you now own . . . or will buy.



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☞ **NEW LUBRICANTS** ahead of new needs . . . developed in close cooperation with machine builders by famous Socony-Vacuum laboratories.

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AN ACCEPTED STANDARD ★ ★ ★

CLASS 9210 TYPE A2
PRESSURE SWITCH

The Class 9210 A2 Pressure Switch is a light duty switch with release valve for the smaller air compressor. The pressure limit is 200 lbs. All standard pressure settings are available. Ratings are 1½ H. P. 110 V., 2 H. P. 220 V. single phase and 3 H. P. 220 V. polyphase. Use it within its rating. It's priced right.

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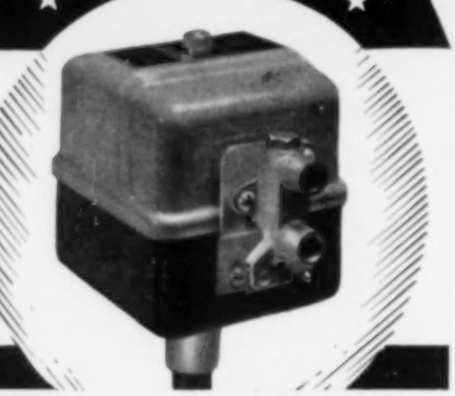
SQUARE D COMPANY • REGULATOR DIVISION • DETROIT



Control —right from the start for—

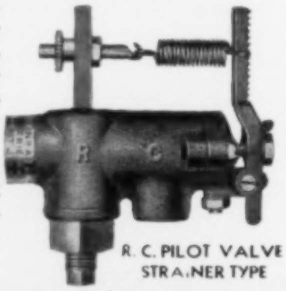
BASIC ELECTRIC STEEL FORGINGS

COMPLETE control of all processing from selection of the melting charge to the finished condition is the N. F. & O. *guarantee of quality* in forgings furnished to your specifications—Smooth Forged, Hollow Bored, Rough or Finished Machined.

NATIONAL FORGE & ORDNANCE CO.
IRVINE, WARREN COUNTY, PENNA. U. S. A.

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure Install an R-C Unloader Pilo valve—let performance prove it. value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



R. C. PILOT VALVE
STRAINER TYPE

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PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

ONE SET OF DIES
THREADS 1″, 1¼″, 1½″, 2″ PIPE
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High speed steel dies can be resharpened many times. Backed by full width taper steps assuring accurate taper and long wear. Tubular handle 24 inches long. Automatic drip oiling. Adjustable rear guide designed for long service and accurate centering. Minimum number of moving parts. No cams.

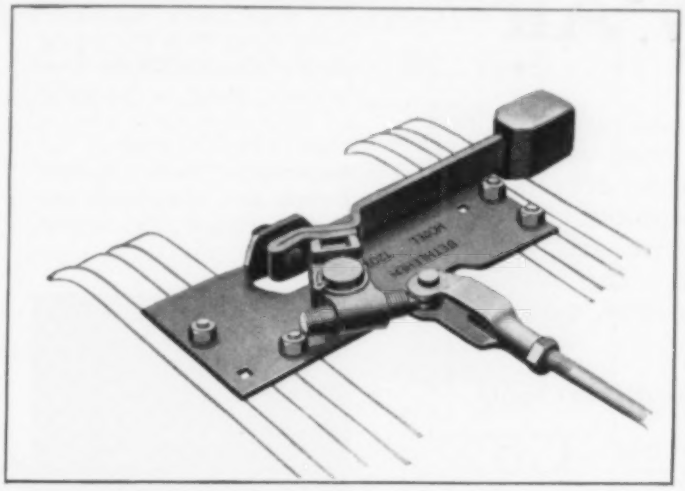
Enjoy easier operation and long service in pipe tools—order a "TOLEDO" SIMPACT from your dealer today.

THE TOLEDO PIPE THREADING MACHINE CO.
TOLEDO, OHIO. NEW YORK OFFICE, 502 NO. 2 RECTOR STREET BLDG.

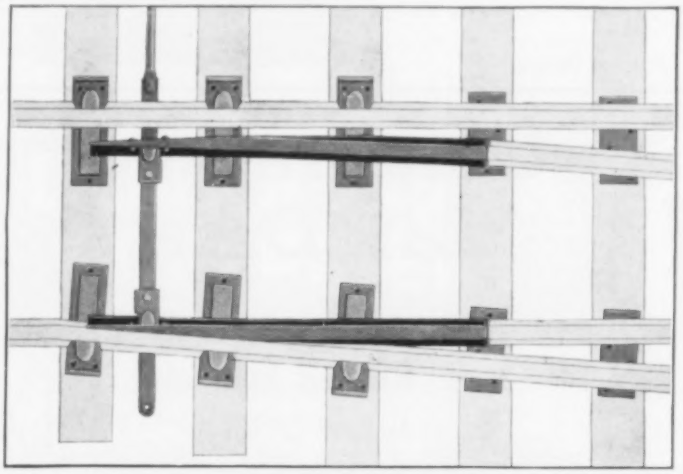
"TOLEDO"

Bethlehem Heavy-duty Mine-track accessories

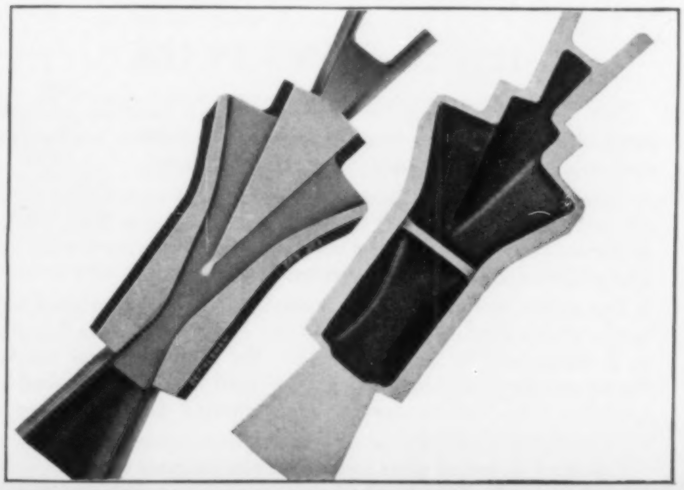
For many years Bethlehem Mine-Track Equipment has been noted for its built-in ruggedness. Increased loadings and higher production schedules are proving to mines, now using Bethlehem products, how well this ruggedness pays.



Switch Stands: Bethlehem's low, parallel-throw switch stands are positive, easily operated and inexpensive to maintain. They have only three moving parts. Model 1201 for light rails up through 30-lb.; Model 1217 for light rails up through 60-lb.; Model 1222 for heavy rails.



Switches: Bethlehem's Heavy-duty switches include heavy slide plates, heavy side-jaw clips, heavy galvanized braces, heavy rods with galvanized coupling bolts. A pair of slide plates for each tie, four heel plates and six braces are standard for all except the 3-ft. 6-in. switch.



Frogs: Bethlehem particularly recommends the one-piece cast manganese-steel frog. No joint bars are required; there are no rivets, bolts or plates to work loose. The steel work-hardens under traffic; cast-in ribs give ample strength.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

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NEW JERSEY METER CO
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MADE IN U.S.A.

"DriAir" gives Dry Air

The DriAir Separator separates and automatically ejects the condensed water from compressed air lines; collects rust, pipe scale, sediment and dirt from the pipes; delivers clean, dry air to tools and other pneumatic equipment. This promotes better and more uniform lubrication and prevents rapid wear, freezing and rusting of tools. The increase in production and the saving in tool depreciation quickly pay for the cost of installing the DriAir.

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Air Meters DriAir Separators Air Jet Blowers

DriAir hangs from the piping (above) or stands on the floor (below). Being a separator and trap combined into a single unit, it requires no attachments, pipes straight through and when once installed requires no further attention.

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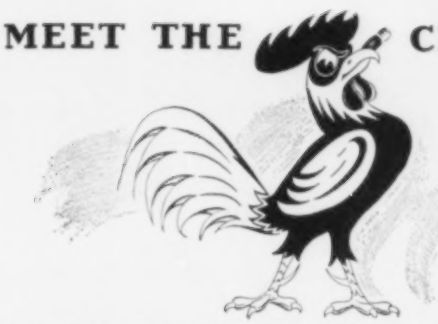

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LITTLE
FIGHTER

APPROVED WILLSON RESPIRATOR No. 5

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Greater wearing and breathing comfort makes this new WILLSON BANTAM a real contribution to workers' efficiency. It is approved protection for a great variety of dispersoids classified by the U. S. Bureau of Mines as pneumoconiosis (silicosis and asbestosis) -producing dusts and mists; also nuisance dusts and mists and chromic acid mist.

WRITE for full information on the WILLSON BANTAM — the toughest light-weight in any ring!

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GOGGLES • RESPIRATORS
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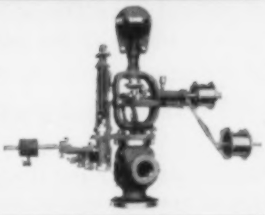
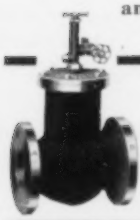
COMPRESSOR EQUIPMENT

SOUNDLY DESIGNED • STURDILY CONSTRUCTED

ERIE GOVERNORS—For steam engines, pumps or compressors. For speed control only or for combined speed and pressure control.





ERIE UNLOADER—Maintains constant pressure by governing inlet of compressor. Loads and unloads without shock or strain.

JARECKI VALVES—Sizes and types to meet every condition, each soundly built, perfectly threaded and individually tested.

JARECKI FITTINGS—Air-furnace malleable fittings...close-grained, cast iron fittings, all with perfect threads. A complete line.

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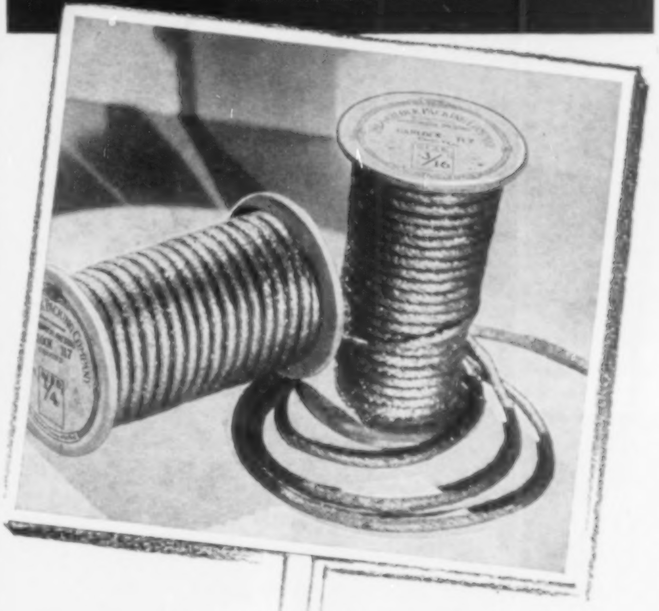
INDUSTRY VOTES FOR GARLOCK 117



IF THERE were elections to pick the valve stem packing that should be used—voting would be little more than a formality, because most engineers and maintenance men have learned from experience that GARLOCK 117 does the job right.

GARLOCK 117 is used on stems of globe and angle valves operating against high-pressure steam, hot or cold water, or oil. It is made from long fibre asbestos yarn, thoroughly lubricated with a special Garlock heat-resisting compound. Furnished either braided or twisted in sizes from 1/16″ up. Specify GARLOCK 117!

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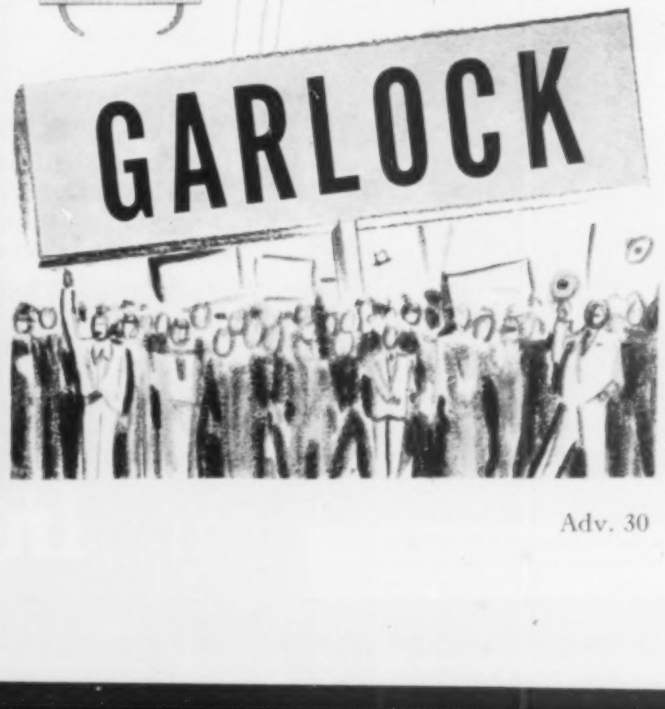
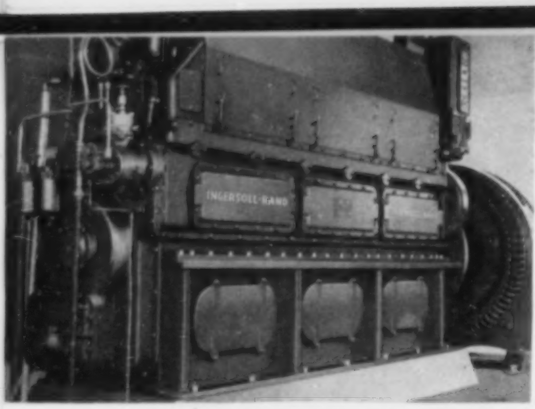
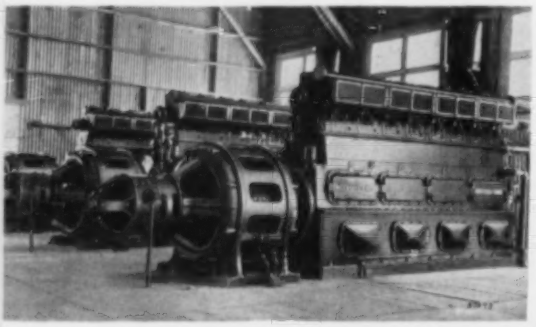
PALMYRA, NEW YORK
In Canada: The Garlock Packing Co.
of Canada Ltd., Montreal, Que.

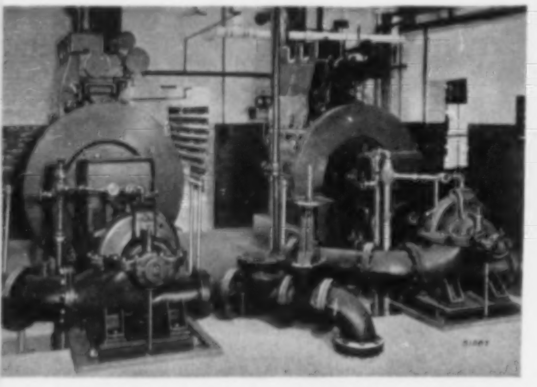




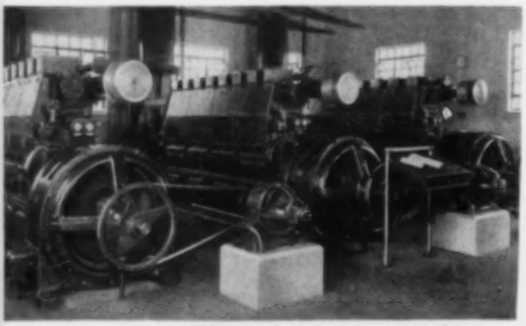
A Type S diesel generating power for a gold mine.



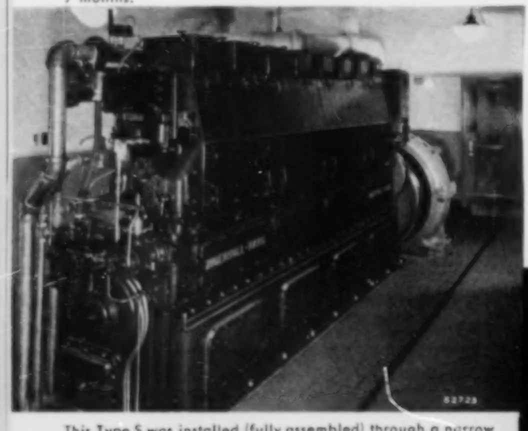
These three Type S units furnished power for constructing a large dam.



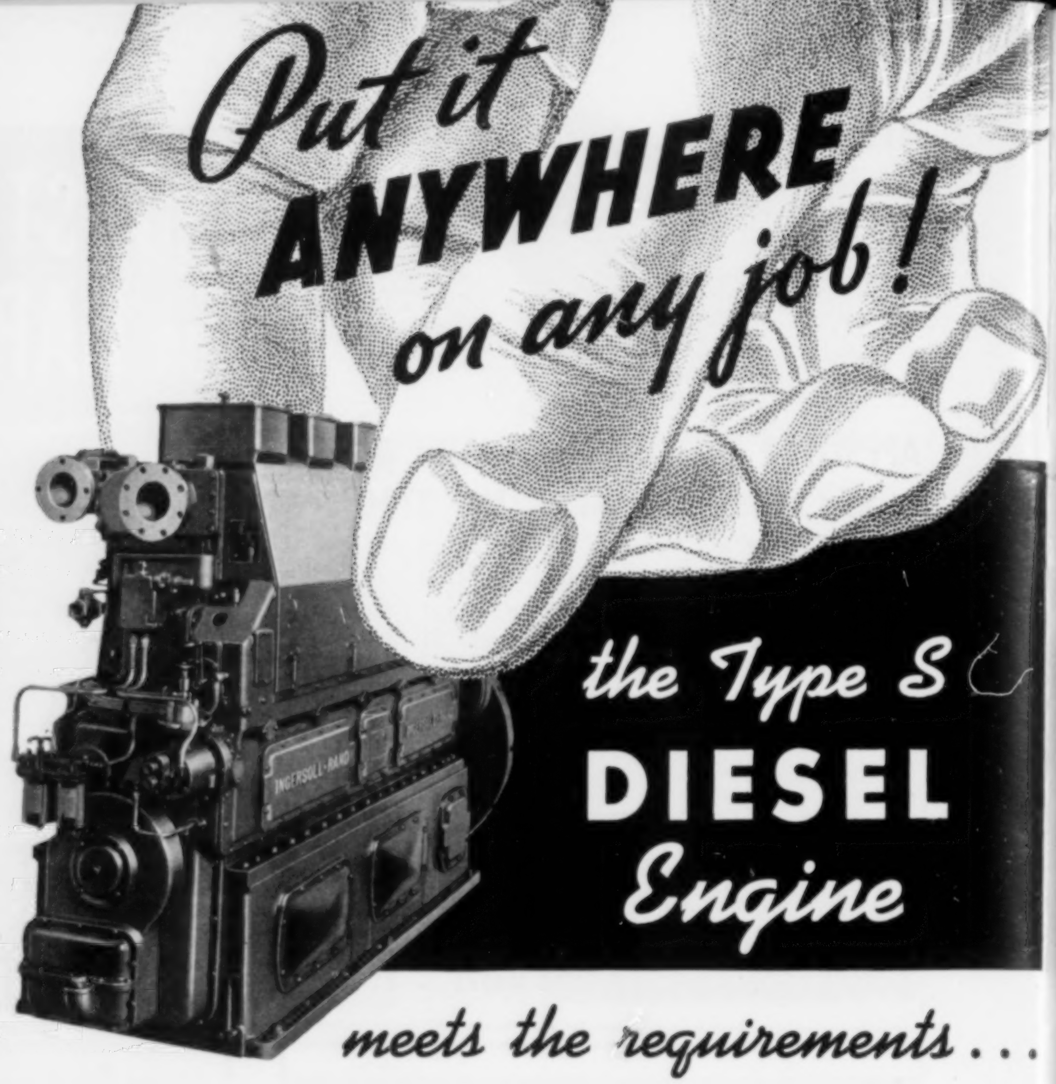
Two Ingersoll-Rand diesel-pumping units in a municipal pumping station.



In an oil refinery 5300 miles from the factory, these 3 Type S engines were put into service by the refinery's own staff, and ran without a stop at practically full load for more than 7 months.



This Type S was installed (fully assembled) through a narrow shaft to furnish power for an office building. Note the low headroom.



Put it ANYWHERE *on any job!*

the Type S DIESEL *Engine*

meets the requirements . . .

- ***Where*** power cost is a primary consideration—it produces one bhp-hr for .38 lb of fuel, and maintenance is low.
- Where reliability under continuous full-load service is essential.
- For any generator drive—the 600-rpm speed makes it possible to use less costly and more efficient generators.
- Where close speed control is necessary to parallel other engines, turbines, water wheels or power lines; or for plants requiring frequency control.
- For variable-speed operation.
- For driving high-speed centrifugal pumps or blowers through single reduction gearing.
- Where there are limitations in floor space, headroom, size of engine-room opening or the cost of transportation and installation. The Type S can be trucked and installed fully assembled; can be passed through a 6 x 9 ft opening.
- For airplane transportation or movement over steep, mountainous roads. (Engines can be shipped dismantled, the heaviest piece being only 2½ tons on the largest engine.)

Because of its ability to meet the above requirements, Type S engines are providing a reliable source of power for manufacturing plants, water supply, irrigation, oil refineries, pipe-line systems, construction jobs, office buildings, mines and aboard ship.

6 Sizes . . . 190 to 510 bhp. . . . 4 cycle, 10½" x 12" cylinders

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Other I-R Products Include: Gas Engines, Compressors, Pumps, Condensers, Rock Drills, Pneumatic Tools and Refrigerating Units.

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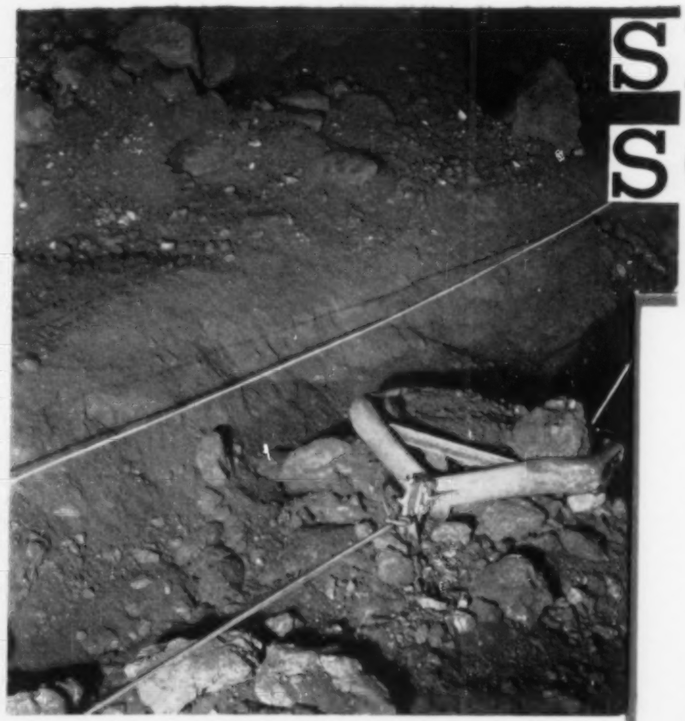

SLUSHING SCRAPERS

THE ORIGINAL HOLCOMB-WESTEECO SCRAPERS

Size M52 Holcomb-Westeeco Scraper pulling iron ore from the bottom of open stope. Note the coarseness of the material being handled.

- 116 COMBINATIONS of different types and sizes in widths 26″ to 66″ inclusive.
- COMPOSED of rigid cast alloy steels.
- STREAMLINED, with rub irons cast integral with side plates.
- REVERSIBLE TOP PLATE for riding purposes.
- PATENTED ONE-PIECE REVERSIBLE ARROWHEAD BLADE, that can be changed in 20 minutes underground—only four blade bolts, well protected, for attaching to back.
- DIFFERENT LENGTH SIDE PLATES fitting most models—also different length harnesses.

Each Holcomb-Westeeco is a composite of the best ideas from the greatest scraping territory in the world . . . the Lake Superior iron and copper regions.

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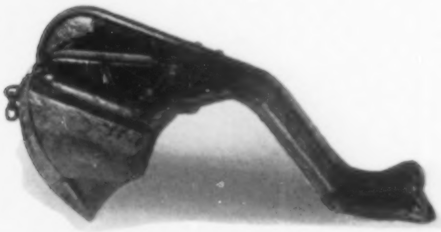
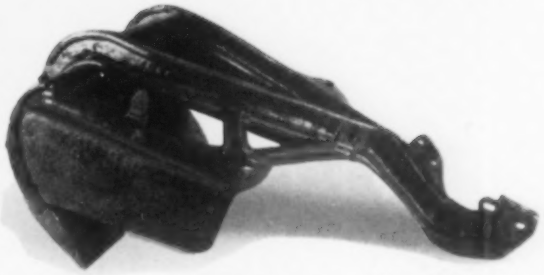
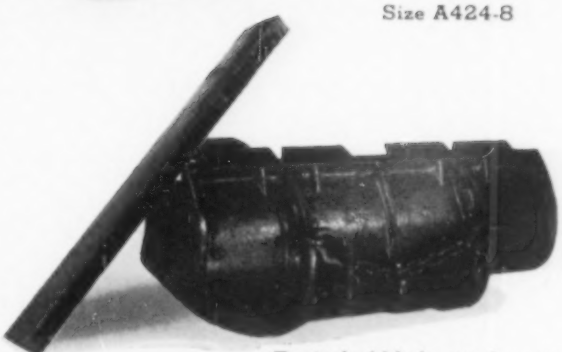


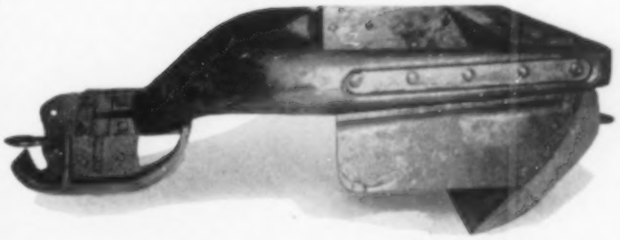
Size AA26-15-6



Size A424-8



Typical of blade attachment



Size M52-8

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HOLCOMB-WESTEECO SCRAPERS ARE IN USE THROUGHOUT THE WORLD

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HURLEY, WISCONSIN - - - U. S. A.

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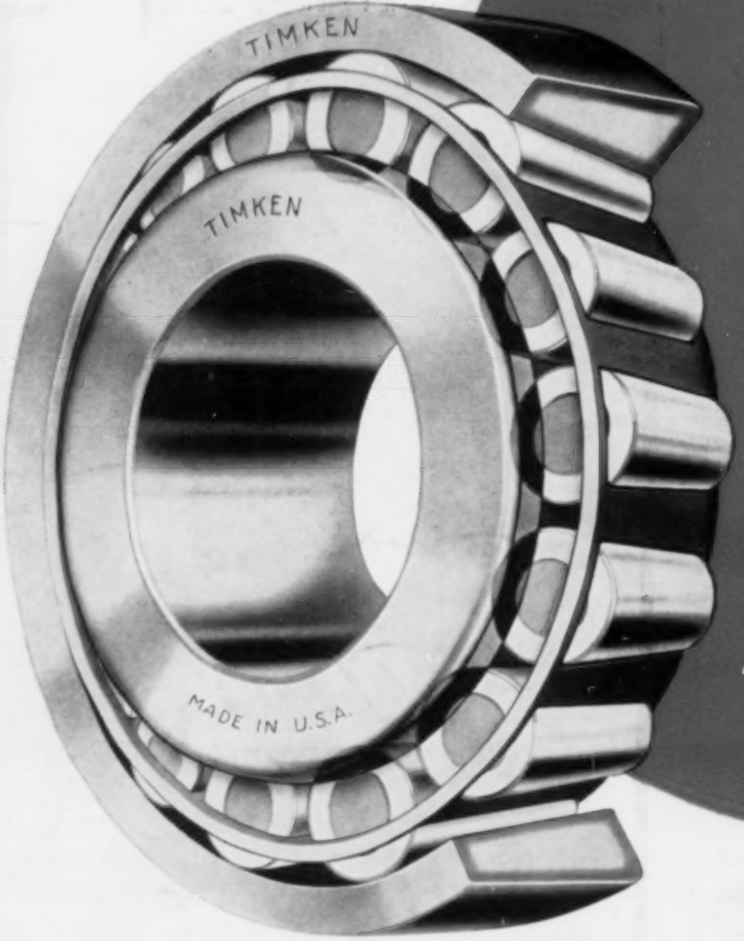
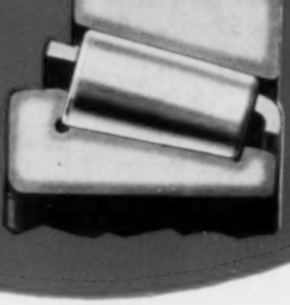


WITH 42 YEARS
OF DEVELOPMENT
BEHIND IT . . .



THESE X-ray pictures show the highly-refined TIMKEN Bearing of today—with all of the vitally important improvements that have been made since Timken introduced the first TIMKEN Bearing 42 years ago. Such improvements as *positive roller alignment* through wide-area contact of roller ends with the undercut rib of the cone; the *one-piece multiple-perforated cage* which assures dead-accurate spacing of the rollers around the periphery of the bearing; TIMKEN Electric Furnace Alloy Steel for supreme strength and endurance; and TIMKEN Bearing finish—the finest finish known to modern bearing science.

The consummation of these improvements has resulted in the highest quality and most efficient tapered roller bearings ever produced—with performance that is correspondingly outstanding; all designated by the trade-mark "TIMKEN" stamped on the cone and cup of every TIMKEN Bearing.

It will pay you well to make sure that every piece of machinery you buy is Timken Bearing Equipped.

TIMKEN
TIMKEN

Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; and TIMKEN Rock Bits.

TIMKEN
TAPERED ROLLER BEARINGS

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